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THE AMERICAN FARM ECONOMIC ASSOCIATION

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AGRICULTURAL PROBLEMS AS SEEN BY AN ADMINISTRATOR

Chairman: H. R. Wellman, University of California

AGRICULTURAL PROBLEMS—AS SEEN FROM WASHINGTON

True D. Morse
Under Secretary of Agriculture

AGRICULTURAL problems have high visibility in Washington; it is not difficult to see them from the Office of the Secretary of Agriculture. It is not necessary to watch the markets closely to find when the price of cattle or wheat has fallen; there are those who are quite ready to call these matters to our attention. Few farmers or Congressmen, however, have reminded us of the high price of hogs, eggs and other products.

In this respect government is little different from the other fields in which agricultural economists operate. As a business consultant and farm manager, I found clients more inclined to write about a crop failure than about a bumper crop, and I am sure that those of you in teaching hear more frequently from the failing students than from those who receive the better grades.

Nevertheless, there are real agricultural problems and it is appropriate that we should be applying constantly our best efforts to their solution. It is in discovering sound solutions that economists have a tremendous opportunity to serve agriculture and the nation.

There are three tasks that must be accomplished before a wise agricultural policy can be laid down.

The first is to agree upon the broad objectives which we recognize as desirable. In a Democracy, this is a task for all of us.

The second is to designate alternative means by which these objectives might be achieved and to indicate the probable consequences of these alternative routes. This is a task for agricultural economists, along with other groups.

The third task is the choice among the alternatives, which is a major responsibility of the Congress.

It seems to me that as a nation we have made some decisions as to broad objectives. These decisions may not be wholly acceptable to any given person, but they command enough support so that they have served repeatedly as a discipline for our agricultural legislation.

The decisions to which I refer are such as these:

Agricultural resources should be used effectively. To destroy food, to hold productive agricultural resources idle and to cause prolonged delay in the adjustment to new technology—these are obstacles to the efficient use of resources which the public will not tolerate idefinitely.

Equality of economic opportunity is a basic right of agriculture and the pursuit of this objective is a responsibility of government. The small size of the typical farming unit and the limited bargaining power of farmers make it necessary that agriculture receive public assistance in research, education, and marketing.

Farmers should be protected from the more violent price fluctuations of the free market. It is generally agreed that the wilder gyrations of the free market do not serve a useful economic purpose and that farmers, being uniquely exposed to the effects of these fluctuations, should be afforded some protection against them.

If these are objectives of agricultural policy, then we are ready to ask the economist for his contribution; what are the means by which we may achieve these objectives?

Secretary Benson, in effect, has asked you this question. We have under way a full scale review of proposed agricultural legislation, involving the cooperation of over 60 different task forces and other groups throughout the country. Included are the agricultural colleges and a number of committees within the Department of Agriculture. Many of you in this audience have aided in preparing replies to the Secretary's questions.

The Secretary has written to thank each group for its cooperation, and I wish now to thank you publicly for your very helpful work. It is my responsibility to head this review, and therefore my good fortune to study the summaries coming from your reports. I have been impressed by two things—first, the care with which these reports were prepared, and, second, the high amount of agreement among them.

As viewed from my position of responsibility in the Federal Government, the following general areas of agreement emerge from your reports and therefore command attention:

1. *Some agricultural programs are heading for serious trouble and are in need of adjustment and changes,* according to the weight of opinion,

Drought, war, major inflation and renewed war have rescued some of our farm programs during past years.

Present programs were developed to help farmers pull out of depression. Changes were made to help fight and win a world war. Depression measures have been continued during a period of extreme inflation and some wartime features have been carried too long. Now we need to make further changes to enable farmers to achieve stability and prosperity during the years of comparative peace that presumably lie ahead.

2. *No single solution is appropriate* for all commodities, said our informants. The problems of wheat and of cotton are different from the problems of poultry and vegetables. We should not try to force any particular program on all of agriculture just because it has been found good for one commodity or for one period of time.

By general agreement certain commodities are in considerable difficulty. Among these are wool and the oil seeds. Other programs, such as tobacco, appear to be giving results satisfactory to those most concerned.

3. *Restricted production is not the answer* to "surpluses," with the exception of tobacco and possibly cotton (non-food crops)—according to most studies and reports.

The weight of opinion is that agricultural resources and productive capacity should be used—and used effectively.

The destruction of food, holding land and equipment idle or in limited use, and prolonged delays in putting improved production and marketing practices into use and other such obstacles to the efficient use of agricultural resources—these are not in the long-time best interest of agriculture or the nation.

The practical difficulties of restricting production, particularly in diversified areas are generally recognized.

However, restrictions on production are clearly indicated as necessary if price supports at a rigid high level are to be maintained. This principle is not accepted equally by producers of the various commodities.

4. *The principle of flexibility is generally though not unanimously preferred* over the present system of high rigid supports, by most farm leaders and groups who reported to us. Letters and reports carry such statements as:

"The immediate effect of rigid high supports may be to raise prices and increase farmers' incomes for the current crop. But the long run effect is to stimulate production, stifle consumption, attract imports, encourage competitive products and thereby pile up surpluses. Then follow surplus disposal, acreage limitations, import quotas and the whole host of regulations that must accompany the permanent maintenance of a price substantially above its normal level."

But the reports show full awareness that farmers and other citizens will make the final decisions on this question.

"The choice between rigid and flexible price supports is a choice between differing combinations of economic freedom and security. These concepts themselves are differently interpreted. It is the difficult but unavoidable responsibility of the people themselves to weigh properly the desirable but often conflicting values which arise in the determination of farm policy."

The disastrous drop in cattle prices and the decline in milk prices have brought thousands of farmers face to face with the effects of supported, high feed costs.

More groups are now adopting petitions and resolutions in opposition to rigid and high price supports.

5. *The use of compensatory payments* is indicated by some as a device by which efficiency of the market could be retained while giving a measure of security to the individual. This is suggested by some advisers for consideration if it becomes desirable to move more strongly into the protection of farmers producing perishables.

Under present programs, price support is given chiefly for certain of those commodities which are capable of being held off the market through storage. Other commodities, which bring in about sixty percent of the farm income, are virtually without support.

This situation is not only inequitable, but is awkward economically, as illustrated by difficulties associated with the high supported price of corn and the lower unsupported price of cattle.

Compensatory payments are endorsed by a considerable number of professional people as a means of giving equitable and practicable price support to both perishable and storable commodities. On the other hand, misgivings are evident on the part of many farmers and some professional people with respect to the use of this device.

6. *Two-price plans and multiple price systems deserve consideration*, according to a growing number of opinions. These are discussed primarily in connection with major crops, particularly wheat.

Such plans propose strong support prices for that quantity of the product sold in the primary and domestic markets, and permit sale of additional quantities for secondary uses, or on the world market at competitive prices.

A number of different proposals are offered in implementing such a program. These alternative methods are now under study.

Major advantages claimed for two-price or multiple-price plans are a reduced need for restricted production, a reduced dependence on public funds, and increased freedom to move commodities into export markets.

Difficulties which would have to be overcome are the technical problems of separating the high-priced from the low-priced market and maintaining of proper international relationships.

7. *Use of modernized parity* is being urged, with a transitional parity to help make the change. The advocates point out that is the way to permit price supports to reflect current and changing conditions of demand for products, supplies, and costs.

All who expressed themselves on this point concurred in the above opinion.

8. *More exports of "surplus" farm products* must be developed. This is recognized as a major objective—and will not only help stabilize our markets but will get food to hungry and undernourished people around the world.

There are many obstacles to more world trade—quotas, embargoes, currency restrictions, and exchange regulations resulting from unbalanced trade, low productivity, and political considerations. Moreover, our own domestic price support programs have had the effect of consistently keeping some prices well above world levels and so hindering exports.

We must recognize that the easy-export period, based on emergency wartime and postwar foreign requirements, is behind us. The United States is the world's biggest creditor nation, and our agricultural trade policy must be developed in relation to that fact. Trade is a two-way street. We must import if we expect to export. Our policies must be based on the public interest rather than primarily on protecting individual commodities or services.

Three alternative approaches were suggested as ways of increasing exports through making our prices more competitive.

The use of flexible rather than rigid price supports, which would result in prices nearer the world level.

A two-price system, which would separate the domestic from the foreign market.

Selective export payments out of tariff revenues, authority for which is now provided by law.

It was stated that changes in price support policies cannot alone offset difficulties now encountered in international trade. Increased offshore procurement, increased private foreign investment, and relaxation of restrictive foreign controls against U. S. farm products were recommended.

9. *Droughts, floods and tornadoes* in quick succession have again this year pointed up the need for more adequate protection and reserves against disaster.

Those who responded to the Secretary's inquiry regarding farm pro-

grams brought out the hazardous nature of farming and suggested various ways of reducing and spreading these risks.

Federal Crop Insurance was approved by some and questioned by others, though all agreed that the objective of spreading risks is desirable.

More effective water management was indicated as one way of reducing the weather risk. That this is recognized by Secretary Benson is evident from his speech last July at Fresno, California:

"These recurring droughts—and the contrary problem of frequent floods—in many parts of the country make it very clear that water is one of our foremost and long-time agricultural problems. Water is a problem clear across the nation.

"We must—somehow—some way—build a better defense against drought and meet more adequately the challenge of floods. It is not an exaggeration to say that water—or the lack of it—is steadily becoming more and more a limiting factor in our agricultural and national progress."

10. *Federal marketing agreements and orders* should be more extensively used, according to many suggestions received.

Marketing agreement experience on the West Coast covers over 20 years and appears to be generally successful. For example, there are eleven such Federal agreements operating in California alone. Six cover fresh fruits, two dried fruits, two tree nuts, and one potatoes.

Marketing orders are used extensively in the Northeastern states and in other areas to put milk marketing on a more dependable basis.

Some suggested improvements in Federal Marketing Agreements and Orders were:

Include additional commodities, among them commodities for canning and freezing.

Permit the use of Agreements and Orders for the regulation of type of containers and packs.

Also, research and the assembly and dissemination of market information should be a function of marketing agreements and orders.

11. *Under-employed farm families* should have special consideration, as present price support and other commodity programs do not well fit their particular needs, said our informants. There are about 1.1 million full-time farm operators in the United States who in 1949 had total family incomes from all sources of less than $2,000.

There was some disagreement among our informants as to whether we should disturb the value judgments of those who place a premium on leisure. There were differences as to whether or not this is a farm problem, and as to the allocation of local, State, and Federal responsibility.

Four groups of under-employed rural people are differentiated, and the following approaches suggested by those offering us advice:

a. *Part-time farmers.* The problem of this group lies primarily outside agriculture. The solution is to be found in better off-farm employment opportunities.
b. *Full-time farmers on inadequate units where adjustments to adequate units would be uneconomic.* The solution suggested for this problem lies in the movement of the people from such units and the gradual retirement of this land from agriculture.
c. *Farmers on inadequate units that can be developed or enlarged into adequate units.* Here the solution is supervised credit, individual guidance, and education to stimulate incentives.
d. *Farmers on units producing inadequate incomes because of insufficient working capital and inadequate management skills.* Education and credit can do the job here without getting into the problem of farm enlargement or consolidation.

It is not enough to dismiss the problems of these people by saying that solutions to their difficulties have not yet been worked out. The problems of under-employed farm families will receive increasing attention in the years ahead and we wish to acknowledge with gratitude the contribution of those who have done pioneering work in the field.

Here are some further points which I feel need full consideration.

12. *Family farms are the solid backbone of the Nation.* We are vitally concerned that they be strengthened as they continue to stand as a bulwark against all that is aimed at weakening and destroying our American way of life. The small farms and those producing low incomes need the special attention of all of us.

It has been my privilege in past years to take the lead in "Rural Development Programs." This was pioneering work in areas of small farms with low incomes. It was done in States like Mississippi, North Carolina and West Virginia, in communities where the average farm size was as low as 40 acres. This has been most constructive work, because of the economic and social importance of farm families.

13. *There is growing concern about the waste and destruction of resources invited by some phases of farm programs.* For example, farmers and taxpayers see money spent by the government on one hand for soil conservation, while high crop prices cause some farmers to plow land that should be kept in grass.

Hillsides that erode and thin soils that should not be cropped are too often planted to row crops and kept in cultivation.

The return of drought and dust storms is causing more people to question the effectiveness of present farm programs in conserving our soil.

14. *Soil building must be the goal*—it is not enough merely to conserve what we have. "Soil conservation" is out-of-date on our best managed farms, ranches and plantations.

The most able farmers are building soil fertility and the productive

capacity of their land. They have long since ceased to be satisfied with mere soil conservation. Leading farmers are building their farms into more productive "factories" and are thus increasing their security and profits.

15. *The farmer will continue to be the master of his own economic fate.* Through more than 26 years of farm, ranch, and plantation management experience, that took me into most of the states, I was thoroughly impressed with the fact that each farmer largely controls the extent of his profits—not the government. That is as it should be.

Agricultural problems as seen from Washington have deepened my impression that whether a farmer succeeds or fails is primarily dependent upon him and his family.

Government has major responsibility for sound national economic and farm programs. But within the favorable climate which a sound government creates—the degree of success of a farmer will continue to depend on his individual management and farming ability.

There is no substitute for a good job of farming.

It is for such reasons that we see growing appreciation of the Agricultural Policies of Secretary Benson in which he maintains:

"Our efforts should be to re-orient our present national policies and programs so that they will contribute to the development of a prosperous and productive agriculture within our free enterprise system.

"It is generally agreed that there is danger in the undue concentration of power in the federal government. Too many Americans are calling on Washington to do for them what they should be willing to do for themselves.

"Individual freedom and citizenship responsibility depend upon the principle of helping the individual to help himself.

"Inefficiency should not be subsidized in agriculture or any other segment of our economy."

Secretary Benson says with emphasis, "President Eisenhower did not become Chief Executive of this country and I did not become Secretary of Agriculture to stand idly by while farmers suffer from high costs and falling prices. We must build workable farm programs."

We are engaged in what is probably the biggest coordinated, privately conducted effort in the democratic evaluation of farm programs ever seen.

The major farm organizations have responded with enthusiasm to the invitation to get the issues debated and fully considered—out in the country—at the "grass roots."

As I mentioned earlier, over 60 work groups of farm leaders at the agricultural colleges, directors of research, and other authorities, were requested by the Secretary to study various phases of price support legis-

lation and other proposals. Perhaps over 500 people participated in this work—among them were the best qualified professional men in their field that the country has to offer.

A wide variety of organizations and groups have prepared reports and recommendations for our consideration.

Many thousands of letters carry suggestions and recommendations.

All are being given consideration and the ideas are being summarized as a guide to changes that should be made in the farm programs.

Congress has the difficult task and major responsibility for enacting the farm program laws. When they pick up this task we will be ready with answers out of the experience and judgments of the farmers and citizens who desire to be of real service to agriculture and the Nation.

This is another appeal to you from Secretary of Agriculture Ezra Taft Benson—and all his staff—to let us continue to have your help and guidance. The members of the American Farm Economic Association, the Western Farm Economic Association, and other constructive leaders can make a great contribution. Farm programs must be economically sound.

No agricultural program, however wise, will be acceptable if the people do not understand it. Unwise programs will continue to be advocated so long as the people are not sufficiently informed regarding the principles of economics. This indicates the very heavy responsibility that weighs upon you, to raise the level of economic literacy so that the people will not ask their Congressmen for things which are impossible of fulfillment or impractical. People must be able to distinguish the statesman from the demagogue.

There is a big educational job to do. We must teach sound principles in the classroom and in the extension program. We must bring to bear the lessons of the past and project sound plans to meet future conditions.

If people know the facts and understand principles, they will make sound decisions.

The future for agriculture was never more secure and full of promise. But, sound direction is necessary. Working together, constructive citizens can continue to keep agriculture and the Nation on a solid path of progress.

SURVEY OF CONTEMPORARY AGRICULTURAL ECONOMICS*

Chairman: O. B. Jesness, University of Minnesota

A SURVEY OF CONTEMPORARY AGRICULTURAL ECONOMICS

O. V. WELLS
Bureau of Agricultural Economics

Agricultural Economists in Our Society

TWENTY-THREE years ago, in a seminar conducted by three distinguished members of this society, I raised two questions which have haunted me ever since. So I now propose to rid myself of these two conscience-troubling friends, passing them along with some comments to the members of the two associations whose achievements, or failures, must yield the final answers.

As I look back, I realize that the invitation for questions on the part of our seminar leaders was chiefly an ice-breaking gesture; and I am not at all certain that the questions themselves were not more a function of incredulous innocence than of any wit. At least, we proceeded through the seminar without ever actually taking a look at the possible answers, and I am inclined to think some agricultural economics majors still go the route without much conscious analysis of such matters, even when they go all the way to a Ph.D.

The questions are simple enough: (1) *What kind of relative returns can agricultural economists expect in terms of money, intellectual achievement, and leadership?* and (2) taking into account the fact that most agricultural economists are educated at considerable public expense and many of them spend a large block of their working lives on public payrolls, *What contributions are agricultural economists making, or likely to make, to the general welfare?*

Answers to these two questions not only vary for different individuals but equally, the answers may change through time. However, there are some relevant observations we can make, based upon performance records over the three decades which have elapsed since the Bureau of Agricultural Economics was formally established on July 1, 1922, and

* The views expressed in this paper and any responsibilities attaching thereto are of course the author's own. Yet certain acknowledgments are also necessary: to H. R. Wellman for suggestions advanced in various conversations and to the Staff Seminar of the Department of Agricultural Economics, University of Kentucky, for the opportunity to give a preliminary version of this statement a trial run before a live audience (April 1953).

the authorization under which most of the College departments were founded was written into the Purnell Act, approved February 24, 1925.

Certainly it seems the answer to the first question is generally a satisfactory one. Although agricultural economists are not notoriously well-paid, their salaries and standards of living within the Colleges and the Government appear to be as good as that of any other professional class performing similar tasks for institutional employers, while many of our colleagues have graduated into other fields of endeavor where some of them are doing very well indeed. Further, returns to a professional group such as agricultural economists are by no means merely a matter of money alone; intellectual achievements and the leadership influence of a professional man's work must also be considered.

As for the ability of our colleagues to make good in the business or commercial world, we all know specific cases. Several of our greatest trading concerns have agricultural economists, or former agricultural economists, in their top executive echelon. One of the ablest members of these two associations also happens to be an executive vice president of the country's largest bank. Agricultural economists occupy responsible positions with many of our processing or manufacturing corporations; and I can personally recall several good extension or "agricultural outlook" economists who have gone into business on their own and made good.

On the leadership front, the score is equally good. The old complaint that Deans, Directors, and College Presidents couldn't really be expected to understand agricultural economics is losing force. There are now about 20 Deans, Directors, Provosts, Vice-Presidents, or Presidents of Land-Grant Colleges who started as agricultural economists, including our distinguished President who is also Vice President in charge of all agricultural activities of our largest single university system.

Nor have the agricultural economists been unable to hold their own with the general economists. Chicago, Stanford, and Harvard have given top assignments to men interested in food and agriculture, while the first Chairman of the President's Council of Economic Advisors started his professional career as an agricultural economist and was in fact a past-President of the American Farm Economic Association.

When we turn to the second question—the question as to what the agricultural economists contribute to the general welfare—the answer again seems to be favorable.

In a way this takes us into the often controversial field as to whether agricultural economists should or can influence public policy, as to whether they should express value judgments or in more graphic terms, whether they should systemically endeavor to "win friends and influence

people." So far as I can determine, this is purely a surface argument, having to do, not with whether the agricultural economist's work is related to policy, but rather with the way in which his facts can best be brought to bear, his influence most appropriately exercised.

Agricultural economists along with their facts and analyses can and do influence policy. And it further seems to me that they have made a significant contribution to the national welfare in the last 30 years by: (1) constantly striving for as many facts as possible, with accompanying endeavors to so organize their materials as to keep the main political arguments to questions of policy, not fact; (2) constantly pointing out at least the worst fallacies of both the all-out advocates of farm aid and their opposites, those who feel the best answer to all farm problems is simply a ruthless freeze-out; and (3) by consistently endeavoring to promote economic education among farm people and their representatives in the belief that the maximum possible number of decisions should be made by farmers and those who handle farm products, the minimum number of trade barriers erected.

One index of this relation of agricultural economists to agricultural policy is found in their actual relations to the Congress and the various administrative agencies. Economic materials and arguments are constantly before the Congress and many agricultural economists graduate into administrative or policy-forming positions. Numerous examples come to mind: The Federal Farm Board drafted the Cooperative Marketing Division as a service unit and included a chief economist on its staff; the original AAA included several outstanding agricultural economists on its top staff, and this is equally true of its successor agencies today as emergency influences subside and the U.S.D.A. again faces some aggravating problems. Currently, the Secretary of Agriculture, the Under Secretary, and the Assistant Secretary for Commodity Operations are all men who have worked as agricultural economists, while the last five governors of the Farm Credit Administration have also been drawn from our field.

One could of course argue that men with an agricultural economics training are not necessarily any more or any less devoted to the national welfare than are other people. But many of them have turned in first-class performances by anybody's standard, and it is my observation that the agricultural economists are as tolerant of other viewpoints and act as often in the public interest as any group with whom I have come in contact.

Agricultural Economics Today

I should now like to turn to somewhat more technical matters—to a survey of the current state of our methodology, of our literature, and of agricultural economics as an applied science.

Renewed Methodological Interest

Any active, expanding science is likely to be marked by a keen interest in new or improved methodologies, with some spirited discussions as to what methods are best.

This was certainly the case with the agricultural economics of the 1920's—there was a whole range of new techniques under discussion in relation to both research and the application of research results, along with a lively criticism of older methods which did not always endear either the skeptical young men or the older innovators to their more conventional colleagues. This interest in new or better methods largely disappeared in the early 1930's as agricultural economists found themselves drawn into administrative positions and policy arguments, creating a situation that continued through World War II.

Are we now in the midst of a revival?

Probably so.

There are, I believe, five leading papers on methodology scheduled for this annual meeting—including Waugh's survey of general developments. So I need not overly concern myself with specific techniques, with either the possible faults or coherent beauties of probability sampling and specified error limits; linear programming; or the effort to fit whole systems of economic behavior into simultaneous structural equations, inter-industry analyses, or into one of the more flexible but even wider-ranging synthetic models which seem to find increasing favor. We also have a whole new set of terms, methods, and differences growing out of the revived interest in marketing work.

I have some reservations about some of the trends in this field. But these are secondary matters; it seems to me that our current interest in methodology is all to the good.

A Flourishing Literature

What about agricultural economics literature?

We can certainly agree it is abundant. The critical question then turns on an appraisal of its quality, which forces us back once again to matters of personal judgment.

Without any effort at formal listing or completeness, suppose we consider some of the more recent offerings, starting with the Association-sponsored *Readings in Agricultural Policy* edited by O. B. Jesness (1949).

The reception of this first book was so good that (a) the Association actually made some money above costs, and (b) a second sponsored book was authorized—*Readings in Agricultural Marketing* under the editorship of F. V. Waugh. Obviously, the arrangements for this book were prompted by the renewed interest in marketing flowing from the enactment of the Research and Marketing Act of 1946.

This also explains in considerable part why F. L. Thomsen turned out his new text *Agricultural Marketing* (1951) and the plans of the U.S.D.A. to use marketing as the topic for its forthcoming Yearbook for 1954. Meanwhile, Waite and Trelogan's *Agricultural Market Prices* (1948) has been well enough received to warrant a revised edition (1951).

However, despite several good texts for undergraduates and some good commodity studies—e.g., R. G. Bressler's *City Milk Distribution* (1952) and W. H. Nicholls' *Price Policies in the Cigarette Industry—A Study of "Concerted Action" and Its Social Control, 1911-50* (1951)—there is still no wholly satisfactory book dealing with an advanced theory of marketing. In fact it seems to me that this is still the field in which agricultural economists are the least sure, the field where they are most inclined to get lost in an ever-growing mass of detail.

Meanwhile, H. C. and Anne Dewees Taylor's long-awaited *Story of Agricultural Economics* (1952) contains a wealth of source materials and observations bearing on the origins and development of agricultural economics to about 1933. This book will, I think, become a standard reference and I also suspect this will be one of the uses for Murray Benedict's *History of Agricultural Policy* (1953). A related book is Carl C. Taylor's *The Farmers Movement, 1620-1920* (1953).

A number of younger economists have been trying to restate and more precisely define farm management theory. The most discussed new book in this field is Earl O. Heady's *Economics of Agricultural Production and Resource Use* (1952). This book brings together and systematizes the views which Heady has been developing in various articles over the last several years. I find the book easier to read than one might suspect, with many of the sections suggesting more than is actually said. Meanwhile, Lawrence Bradford and Glenn Johnson as well as Norman Efferson have farm management books scheduled for release this fall.

S. V. Ciriacy-Wantrup's *Resource Conservation: Economics and Policies* (1952) is the newest offering in the field of land use or resource development. Meanwhile, Marion Clawson and Mont Saunderson have both released books dealing with public land management, while I understand that John Timmons and V. Webster Johnson both have books in process. Research-wise, I still give top rating to Leonard Salter's thesis, *A Critical Review of Research in Land Economics* (1948).

Recent books dealing with general principles and agricultural policy are plentiful: For example, John D. Black's *Introduction to Economics for Agriculture* (1953), Theodore W. Schultz, *Economic Organization of Agriculture* (1953), J. K. Galbraith's *American Capitalism* (1952), Harold G. Halcrow's *Agricultural Policy of the United States* (1953), and various books which we have been promised during the coming year, especially

the policy book by Rainier Schickele and the appraisal of current agricultural policies by Murray Benedict and O. C. Stine which is being sponsored by the Twentieth Century Fund. Geoffrey Shepherd has reworked his *Agricultural Price and Income Policy* (revised 3rd Edition, 1952).

A refreshingly different kind of study dealing with policy comes from one of our political scientists, Charles M. Hardin, in a book on the actual mechanics of how policy is made, *The Politics of Agriculture,* with the subtitle, "Soil Conservation and the Struggle for Power in Rural America" (1952).

John D. Black's book is actually a textbook. Yet he has his usual say about a number of things. Schultz' book is his most serious effort since *Agriculture in an Unstable Economy,* which I still rate as one of the best-written, most provocative items left from the great post-war planning effort.

Galbraith's endeavor is to develop in formal terms and popular language (a somewhat surprising dual goal for an economist) the "concept of countervailing power." Galbraith's one chapter on agriculture explains the continuing pressure for farm programs, arguing that the relevant issues have to do not with whether there shall be farm programs but rather with simpler matters of form and content.

This brief review omits mention of much recent literature—for example, D. Gale Johnson's two prize-winning books on forward prices and foreign trade; innumerable articles, bulletins, etc., including the most interesting report of the Farm Foundation's 13-man Committee, *Turning the Searchlight on Farm Policy* (1951). But the essential point is that agricultural literature is in a flourishing state. Some of it seems to me to be of excellent quality, quite a bit of it clearly controversial.

A question was raised as to the quality of articles appearing in our own journal as compared with those of similar associations. Quality in journal articles is, I suspect, a function of the editor's ability and choice, influenced by the available supply of offered articles. Over the last few years, I believe our editors have had no difficulty on the second score. Any judgment here is difficult, further complicated by the fact that each journal covers a somewhat different subject-matter field.

Perhaps the best approach is to ask whether our own writers have too much difficulty getting articles in other journals. Apparently not.

Agricultural economists from time to time have articles in the *Journal of Political Economy,* the *Annals of the Academy of Political Science,* and *Econometrica.* I find a leading note by John D. Black in the last issue of the *Quarterly Journal of Economics* (Vol. LXVII, No. 2, May 1953) and a full-scale article by Bushrod Allin promised for the next issue; F. V.

Waugh has articles in the last two issues of the *Journal of the American Statistical Association;* while D. Gale Johnson and Holbrook Working contributed two of the four main articles in the most recent issue of the *American Economic Review* (Volume XLIII, Number 3, June 1953). Scholarship among agricultural economists is good enough to assure articles which editors of any of our leading economic journals will accept.

Agricultural Economics as an Art

We used to argue as to whether the social sciences were in fact sciences at all; as to whether land use, farm management, marketing and agricultural outlook work were anything more than applied arts—activities without any real base in science. This argument has largely vanished.

However, agricultural economics is far more than an academic discipline. There are agricultural economists in almost every agency dealing with agriculture at the Federal level, many of those at the State level. Further, farm organizations, farm management and appraisal services, and the Federal-State Extension Service employ large numbers of agricultural economists. Commercial organizations account for another large block of personnel, while a number are doing statistical work, serving as agricultural attachés overseas or on technical assistance assignments with Mutual Security or Point IV.

Not much more needs to be said on this point. Most of these men are doing a competent job, some are outstanding. And I have already indicated that I believe their influence on agricultural and other public policies is beneficial.

I would like to add a few words about agricultural outlook work. I am constantly surprised to see how widely the agricultural outlook materials of the Bureau of Agricultural Economics and the State economists (both Experiment Station researchers and Extension economists) are quoted, how much these materials are actually used. Professional farm management services are also doing some very effective work. Several farm organization and Extension leaders feel that the further exploitation of this *outlook service-farm advisory* field would pay very well.

Neglected Areas

I should not like to leave the feeling that all is well with contemporary agricultural economics even though we are reasonably successful in terms of influence and financial rewards, even though we are still curious enough to hunt whole armies of new facts and argue complex methodologies, even though our literature is flourishing and our graduates have little difficulty in finding jobs, either commercial or Government.

Some neglected areas need to be considered.

As a first guideline, suppose we turn to the discussions of the Social Science Research Council's new Committee on Agricultural Economics. For several years, the Council has felt that it would like to again enter the agricultural field. The question has been what could best be done and the decision was finally reached to start with a select committee which would endeavor "to identify current limitations of work in agricultural economics and the nature of remedial measures which might be proposed."[1]

The Committee agreed that "an over-all survey or appraisal of the current state of agricultural economics would not only constitute a burdensome and expensive task, but that available resources of time and money should instead be directed toward more specific objectives." But after considering various alternatives, the Committee did recommend:

(1) A project evaluating existing knowledge and research bearing on the factors responsible for the persistence within the U. S. of agricultural areas of low income and low productivity in spite of general agricultural prosperity. Closely tied to this would be an appraisal of past research relating to low-income areas and their economic development, including analysis of the close intermingling of farm and nonfarm activities in some areas which can no longer be considered as falling strictly within the farm field.

(2) That research handbooks be prepared explaining the use and limitations of research techniques now in use or on the horizon. There was some discussion as to whether the handbooks should deal with techniques as such or whether it would be better to start with some of the main problems needing analysis, specifically indicating the way alternative research methods or techniques might best be used.

(3) That the Council explore possibilities for financing the development of professional competence among research workers by means of refresher courses, to enable experienced research workers to deal more effectively with a wider range of problems; and that efforts be made to increase fellowship opportunities for workers in agricultural economics.

These suggestions cover two of the fields which I would class as "neglected areas," neglected in the sense that the relative amount of attention going to them seems too small. That is, we need to give more attention to the problem of farmers and farm families which fall in the low-income group and as already indicated, there is currently a healthy

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[1] The Committee consists of H. Brooks James, North Carolina State College (chairman); Lee R. Martin, North Carolina State College (secretary); R. G. Bressler, Jr., University of California; J. K. Galbraith, Harvard University; Earl O. Heady, Iowa State Colloge; D. Gale Johnson, University of Chicago; Glenn L. Johnson, Michigan State College; William H. Nicholls, Vanderbilt University; Kenneth H. Parsons, University of Wisconsin; and Frederick V. Waugh, Bureau of Agricultural Economics. See the newsletter of the Social Science Research Council, *Items* (Volume 7, Number 1, March 1953).

revival of interest in methodology which should be further encouraged, including attention to the problem of seeing that methods are better understood.

However, some additional areas also need to be considered. One of these has to do with the problems of price structure—that is, a consideration of the factors which affect the general level of farm prices and influence long-run trends and the other with general problems of the social structure and functioning of the communities in which farm people live and work. There are some questions with respect to each of these four neglected areas which I want to raise. These are:

(a) *Methodology:* Although we are all interested in methodological development there is a question as to whether some of the current interest may not be a retreat from actual analysis of problems at hand.

I shall certainly not labor the point since it is well covered in Waugh's paper. But I do recall that in a recent appearance before the Econometric Society, Karl Fox so far relaxed himself as to allow a few words of ordinary language to intrude, when he asked his audience to consider "a concrete, non-trivial case." I am sorry to say that there are always a host of "concrete, non-trivial" cases facing farmers, administrators, and the Congress. Nor do these cases wait. It is not always a sufficient answer for statisticians and analysts to suggest that they be left alone in order that their current thoughts may be most useful in solving future cases whose shape and timing are not yet defined.

Further, there are some questions that relate to the new methodologies which also need to be looked at from the administrative standpoint. I take it for granted that funds for statistics and agricultural economics research will always be scarce in the strictly economic sense of that word; and I do find that the methodological specialists are quite often not cost-conscious. We often need survey and analytical methods which can be held within specified cost limits and which will allow answers to particular questions to be developed relatively fast.

Another way of saying this is that one of the most difficult tasks facing the administrator is the decision as to how much emphasis shall be placed on service—i.e., items covered and speed—versus accuracy. There is in both the colleges and the Federal agencies an abiding interest in basic research and a willingness to devote some funds, sometimes considerable amounts, to work of a basic character. But I think it is fair to say that colleges, commercial concerns, and Federal agencies also look upon agricultural economics research and the collection of related statistics chiefly as tools for practical and often immediate use.

(b) *Small farms:* As indicated by the Special Committee, there is a

strong feeling that too little attention has been given to the problem of low-income farmers and the economic development of low-income areas. I am not in disagreement.

Certainly we should all like to see the incomes of low-income people generally improved, whether or not they may be farmers. Further, we all recognize that there are communities where the farm resources associated with most farm families are too few to supply a reasonable standard of living purely from sales of farm products under any price structure that might seem possible. But this is a considerably different problem from the cost and income difficulties facing commercial farmers and should be treated as such. Nor does my interest in more attention to low-income farmers or underdeveloped areas necessarily lead me to the conclusion that that system is best in which the distribution of incomes among individuals and families is most nearly equal.

As I see the central problems facing commercial farmers, they have to do chiefly with the marginal transfer of resources and the equalizing of bargaining strength. Such problems are more amendable to strictly economic analysis than are those having to do with the low-income, small-farm group. Frankly, to solve such problems, it seems to me that some structural changes are involved. We need to know about the possibilities of consolidation and efficient commercial operation of the farming resources involved, area by area, as to how the voluntary transfer of population from farm to nonfarm occupations can best be encouraged, and what means can be used to overcome the various social lags which prevent consolidation on the one hand and transfers on the other.

(c) *Price structure:* The term "price structure" is used for want of a better one. So far the great bulk of our price analysis work has dealt chiefly with season-to-season or year-to-year changes in prices for particular commodities, always with a considerable worship but not much explanation of what we call "the general price level."

This is not entirely true and some of the recent work of Willard Cochrane, some conversations over the last several years with Elmer Working relative to his work on the demand for meat, and sections of Glenn Johnson's recent tobacco bulletin are cases in point.

We definitely need to look at, not only the factors which affect changes in commodity prices from time to time but, also the factors which determine the averages around which these prices fluctuate over a period of years and the trends in these norms or averages relative to one another as well as the structure and differential behavior of various families or closely-related groups of prices within the price level field.

Some friends have already commented that what I am doing here is in

effect asking the agricultural economist to be a general economist. But again, this is something that I take for granted. It seems to me that any agricultural economist who wants to work out mutually satisfactory answers to the two questions with which we started has no choice. He must always realize that he is first of all a general economist who because of special interests or abilities is finding his data and working material in the agricultural field.

We also need to know more about the nature of consumer demand. Some economists at least are inclined to look upon marketing as a passive or neutral function. Not so the salesman and his sales-minded executive—they want to create new demands or an increased demand for products already available. What techniques do we have for helping here? Isn't this one of the trails into the "dynamic, expanding" economy about which we talk?

These observations will perhaps raise the question, among others, as to whether marketing is not also a neglected field. We need more marketing work but the field has had increased attention since the enactment of Title II, Research and Marketing Act of 1946.

As indicated earlier, what I miss here is not studies on how to best pick up and set down cantaloup crates or how much waste can be reduced by prepackaging tomatoes. Such studies can be very useful, but we also need a more adequate conceptual framework for marketing work which would pull together our various, often not too closely related, efforts and give them direction in relation to the real problems as seen from both the producer's and industry's viewpoint.

(d) *Social structure:* Again for want of a better term, I refer to this fourth class of problems under the label "social structure." Some economists would feel the kind of investigations I have in mind here are those which are chiefly of interest to rural sociologists. Perhaps so.

I have always objected to some of our farm management and other analyses which proceed on the assumption that all the farms in a particular community should be optimum-size farms occupied by healthy farm families, headed by an extremely skillful individual with a good financial touch, associated with an equally efficient wife and two selfless children of working age. The fact is that the growth and decline of farm families prevent this, and the fact is that we find small farms and low-income farms (which for various reasons are often not the same) in even our better farming communities. It is a further fact that the problems of education and health, as well as other problems which call for the development of community facilities, cannot be handled on an individual farm basis. The whole community must work together. Perhaps the main key to some of our low-income, small farm problems falls within this field.

Conclusion

In conclusion, it seems to me that what I have done is to work out a cursory rather than a critical review of contemporary agricultural economics. I must also further admit that I have completely failed to discuss the problem of undergraduate and graduate training. However, this is not a field in which I am personally acquainted nor did I have the time to familiarize myself with the problems which need to be discussed.

DISCUSSION—FARM MANAGEMENT

MAX MYERS
South Dakota State College

Mr. Wells is a tactician and an administrator as well as an economist. This is not news to most of us. However, as additional proof of both qualifications your attention is called to the structure of his thought-provoking paper. As a tactician faced with an over-broad battle zone he disposed his main forces elsewhere on the terrain of Economics, leaving only outposts across the green hills of Farm Management, the fertile valleys of Land Economics, and the rocky roads of Marketing. As an administrator he delegated responsibilities for these particular areas to his discussants. Meanwhile, as an economist he gave us all some points to be considered and discussed.

The foregoing remark is made with envy rather than malice. It would be easier to criticize his detailed positions, had he chosen more of them, than to dig in on my own. Nevertheless, I have reconnoitered the area; I have struggled over the mountains of journals and texts and waded in streams of farm management prose. Here then is my hasty report, written in the field and intended to be understandable on first reading. This last characteristic is one which I cannot ascribe to every recent writing in Farm Management.

These comments are opinions and estimates only. They are made from my own recently established observation post. They must be brief and cannot contain a complete or thorough critique of the subject of Farm Management.

Let us pass over Mr. Well's first question and answer, concerning the relative returns to agricultural economists, because I agree in general with his comments and because I wish to devote my limited time and space to his second question i.e., what have we contributed. In the same manner and for the same reasons I shall skip references to recent literature.

Let us consider some favorable and unfavorable aspects of contributions to the knowledge of farm management, from three points of view. These three in the order listed are, the viewpoint of farm operators, of the public, and of the professional agricultural economists.

Farm operators were and are the basic users of our work. Farm operators, as a class are interested in results measured in such terms as dollars, or product, or leisure time gained. They are not concerned primarily with terminology or methodology. Furthermore, assisting large numbers of farm operators toward the attainment of more efficient production, more profitable self supporting businesses and stronger farm families is a way of advancing national welfare.

Therefore, the first and most important favorable item to be mentioned is

this. We have developed means by which the farmer who is willing to put in the effort can be assisted to considerably improve his farm business organization and consequent earnings. These methods and tools have been and are being applied by substantial numbers of farmers. These must be given some of the credit for the increasing efficiency of the nation's agriculture. It is true, at least in part, that the tools and methods, the use of records and methods, the use of records and budgets for individual farms and enterprises are crude and tedious. But such imperfections cannot hide the major accomplishment.

Second, the farmer is getting factual information and outlook estimates of substantial value to him. In addition, he now can obtain information on a large number of subjects closely related to management, such as credit, farm law, and taxes.

Finally, farm operators knowingly or unknowingly, willingly or unwillingly are being driven by forces partly beyond their control into a closer attention to farm management matters. They will be asking for more and better information.

Farmers have some reasons to be dissatisfied with the present state of farm management. There is not enough of it. Although many operators yet lack the motivation to stress management, the others who want assistance and advice find too few county agents, specialists and professional managers armed and equipped to provide the technical know how.

Farmers sometimes are baffled or misled by some of our information. There are numerous reasons for this. They are lost in details on necessarily involved and time consuming calculations, or enmeshed in our controversies over methods. We hand them generalizations which they can see do not fit the particular circumstances, or methods not suited to on-the-farm working conditions

Sometimes the farmer's questions are not answered. This is more likely to occur when he wants to know whether to apply and to what extent to apply a relatively new practice.

In addition we do not always provide management information fitted to the needs of certain categories of operators, such as specialty producers, part time farmers, and subsistence farmers. In our own defense, however, we can say usually that we apply the limited resources available where we believe the returns will be greatest. We by-pass alternative potentially productive fields by necessity, not by oversight.

We should not overlook our main mission, our bread and butter job, unspectacular as it may seem sometimes, of working toward improved farm businesses. Mr. Wells probably touched it lightly in his paper because it seems obvious. Obvious or not, it is a basic job.

The public can and does expect contributions by farm management workers in addition to those channeled through the farm businesses. I agree with Mr. Wells that it has a right to expect these workers to be economists first and applied workers in farm management second.

On the favorable side we can claim some part in the credit for increasing productivity and efficiency of agriculture, which are certainly in the public interest. We have helped to provide the public with more factual material concerning agriculture, its farms and its production than any other nation has had. And we have contributed some part to the analysis of the farm situation as background for policies and action programs.

Mr. Wells places relatively more emphasis on the "fact gathering" aspects and less on the analysis of evidence and alternative courses of action, than I prefer. It is part of an economist's job as an economist, to carry analysis forward to at

least the point of delineation of economic alternatives and the probable economic consequences of each.

Some portions of the public may charge, but unfairly I believe, that to whatever extent we contribute to increasing agricultural efficiency we worsen a situation of "surpluses."

It can with more fairness be said that we have not made the public aware of the differences between increasing efficiency and of encouraging overproduction. Certainly we have not completed the job of farm management education of farmers and non-farmers.

Like Mr. Wells, I believe that the major zone of attack on the too-small farm in areas where they are common lies outside of the field of farm management. However, we have not thoroughly studied the part that farm management can play in solving even a part of the problem.

Although our work with farmers is our primary job, there are at least two reasons lending real importance to farm management efforts directed at the general public. The first is that our information is useful in, and sometimes necessary to, decision making by non-farm people, and governments. The second is a defensive reason. Only by influencing the climate of public attitudes can we hope to be permitted and encouraged to do our best work with the farm businesses.

Our own professional valuations of our work are of interest even although probably less important than the views of the farmers and the public.

On the favorable side it must be said that there is continuing effort to produce more and better professional work. A relatively large number of economists are engaged in farm management resarch, teaching, extension, and other applicatory activities.

We are finding more than enough new ground for the plowing and plenty of disposition to question whether some of our earlier efforts might not have been accomplished more easily or more efficiently.

As we have gained mechanical and electronic assistance in processing the large quantities of data, we have also gained the advice and efforts of those who say "cannot we dispense with some of the materials handling and get the same results by faster means"? Both alternatives seem to be improvements over the past.

I would charge us with two "sins," among others. (1) We have lost sight, sometimes, of our real objectives in farm management, namely those of a more efficiently organized and operated agriculture for the individual farm operators and for the nation. As a consequence we have occasionally chased down side canyons, and we have occasionally set up a total or a method as an end in itself. Sometimes we have failed to obtain data, or process data toward real objectives, but rather have collected information for its own sake.

I am not worried about "flights from reality" or flights from work, or conflicts over method, as long as these occur in sight of understood major objectives. (2) We have hesitated, sometimes, to work in, or speak on subjects where the economic evidence probably will contradict some popular and authoritative recommendations. As an example, we have been tardy in pointing out the limitations from a farm business standpoint on the degree of application within the farm of certain soil conservation practices. The farmers themselves state economic reasons for an unwillingness to go as far as physical scientists tell them will be physically desirable. Have we always been there soon enough with strength enough to evaluate those economic roadblocks? I doubt it.

In some regions and periods we have been similarly reluctant to speak out against overdiversification on farms.

Thus we in Farm Management are engaged in a major effort of direct importance to several million farm families, and of importance less directly to the public. The amount of work needed is increasing. We have made progress and we are making progress. Within our professional family we show a healthy dissatisfaction with our own current level of accomplishment and an encouraging diversity of efforts at doing something about it. If these things were not so the subject would neither demand nor attract the attention of large numbers of economists.

DISCUSSION—LAND ECONOMICS

RALEIGH BARLOWE
*Michigan State College and Bureau of Agricultural Economics**

When President Wellman asked me to accept this assignment, he suggested that I evaluate Mr. Wells' remarks concerning land economics and then fill in the important gaps. Actually, I find myself in substantial agreement with Mr. Wells' remarks regarding the general field of agricultural economics. But as you no doubt observed, he passed rather lightly over the subject matter of land economics. Accordingly, my comments are concerned primarily with the problems of contemporary land economics.

It takes no great amount of critical analysis to recognize that the present situation with regard to land economics research is generally favorable. Progress is being reported in a number of areas, the literature is flourishing, morale is high, and the workers in this field are encountering what appears to be an endless stream of new and challenging problems.

This observation would not be complete, however, without some mention of the less favorable side of the picture. The record of the past three decades strongly suggests that the fortunes of land economics have a somewhat anticyclical flavor. Progress has been made in all periods; but from the standpoint of size of appropriations and numbers of personnel, land economics—in the Bureau of Agricultural Economics at least—fared better during the depression than in any other period. The past decade has been largely a period of retrenchment during which many of our workers have migrated to other jobs while only a limited number of new workers have been recruited. Fortunately, most of the new recruits have come with more and better professional training for their work than was the general case two decades ago.

Importance of the Land Problem

Now that I have given you a general summary of my survey of contemporary land economics, let us look at the situation in more detail. Land economics, as most of you know, is concerned primarily with the variety of problems and situations in which land, its use or its control, might be regarded as a factor of strategic importance. As a field of inquiry, it involves use of a factoral approach that has agricultural counterparts in the fields of farm finance, farm labor, and farm management. Like these other fields, the content of land economics over-

* The views expressed in this discussion are the author's and do not necessarily reflect those held by either of the organizations with which he is affiliated.

laps with other classifications. A considerable segment of its content overlaps with production economics. Other segments involve aspects of marketing, the treatment of land as a consumer good, and a strong element of public policy.

One hundred years ago public interest in the land question in this country centered for the most puart in ways and means for disposing of the public domain. A little later Henry George raised the single tax issue. Then around the turn of the century the scope of public land policy—and with it the scope of the land problems on which economists could expect to work—began to spread like a vast opening fan. Resource conservation and land reclamation were the first two subjects to capture national interest. In the decades that followed land credit, land values, public land management and the creation of a new public domain, land tenure, large scale resource development programs, the submarginal land purchase program, land classification, land use planning, zoning and land use controls, and housing programs also became public issues.

Many of these land problem issues came into the limelight during the depression of the 1930's. With the return of more prosperous times it has only been natural for problems such as submarginal lands and tax delinquency to fade into the background. But other problems have risen to take their place. The overall importance of the land problem is as great now as it ever has been; and the future will probably pose more, rather than fewer, problems.

In some respects this view would seem to run counter to other observations concerning a decline in the relative importance of agricultural land. Let us remember, however, that this relative decline stems from the greatly increased returns realized by capital and labor in our society rather than from any net decrease in the importance of agricultural lands. With increasing population pressure, larger family incomes, better transportation facilities, and other similar developments, it is reasonable to expect a tremendous increase in the demand for a variety of land uses. This almost inevitably will lead to more and more conflicts of interest between people over the use of land.

Land will be needed for urban purposes, for living space, for recreational and service uses, and for the production of food, fibers, and forest products. The problem of future land requirements for agricultural production may not seem too pertinent in a year when we are voting on marketing quotas. Yet it is a problem that we should face squarely. Over the long-run the answer to this problem calls for a horizontal as well as a vertical approach. In other words we must look to the extension of agricultural production to new lands as well as to the intensification of production on those lands now in use.

Much of the potential impact of the food and population problem on land in the past has been averted because we have been operating in a period of increasing returns. This situation will probably continue throughout our time. But over the long run, the land problem is bound to become more and more critical unless we either stabilize population numbers at a reasonable level or somehow accomplish the highly unlikely miracle of ever-increasing production.

Current Land Economics Research

Returning to the present, most observers will probably agree that considerably more is being accomplished in land economics research than in either the teaching or extension aspects of this field. So far as research activities are concerned numerous studies are now underway in our colleges and universities, in the Bureau of Agricultural Economics and other research agencies of the

Department of Agriculture, in the Department of Interior, in the Housing and Home Finance Agency, in the State Department and the new Foreign Operations Administration, in the Food and Agriculture Organization of the United Nations, in state conservation departments, in metropolitan planning commissions, and in numerous other agencies, foundations and groups.

Most of the agricultural land economics research work underway may be classified under the four major headings used by the Division of Land Economics. These are: (1) studies of the economics of land and water resource use, development, and conservation; (2) land value and land appraisal studies; (3) land tenure studies; and (4) studies involving other land problems such as property rights, public controls over land use, and various aspects of land policy.

Time does not permit a detailed discussion of these areas of study or of the numerous projects that are underway or that should be initiated. Suffice it to say that important work is underway in each of these areas. Also one might observe that a high proportion of the resources in land economics in recent years has been devoted to studies of resource development, the evaluation of various irrigation and flood control projects, and the development and testing of cost-benefit analysis techniques. This type of work has high merit and should command considerable attention and resources in the future

Perhaps one of the best measures of progress in land economics research is the current flourishing state of the literature. Mr. Wells has mentioned the recent books by Clawson, Heady, Salter, Saunderson, and Wantrup and the forthcoming books by Timmons and by V. Webster Johnson. In addition to these, mention may be made of Ackerman and Harris' volume on *Family Farm Policy*, Timmons and Murray's collection of essays on *Land Problems and Policy*, Louise Peffer's monumental study *The Closing of the Public Domain*, the 3-volume report of the President's Water Resources Policy Commission, the Proceedings of the Madison Conference on World Land Tenure Problems, Harrison's monograph *Levee Districts and Levee Building in Mississippi*, and the forthcoming books by Harris on the genesis of our land tenure system and Huffman on irrigation economics—to say nothing of a considerable flow of bulletins, reports, and articles.

Challenging Problems

Let us now turn to some of the challenging problems of the future. For the sake of brevity and clarity I have classified these into three groups: (1) emerging areas of research, (2) further integration of the work within the field of land economics, and (3) methodological issues.

Emerging Areas of Research

From my earlier discussion it may appear that we have enough land economic problems now to occupy our resources for years to come. But we must be ever mindful of new emerging problems. The tenor of the times suggests that more attention be given to the problem of public vs. private ownership of various types of landed property. In the international field more attention is being given to various aspects of land tenure and resource development. Continued work is needed, of course, on a number of problems such as the economics of conservation, the development and use of land and water resources, land market developments, farm leases and rental rates, and methods of getting started in farming. Well deserved attention might also be given

to the effect of agricultural price programs on land use and to the counter-impact that land programs can have on agricultural production.

As I see it one of our big challenges involves the interrelation of our work with that of workers in other fields such as soil science, agricultural engineering, law, and political science. Even within the broad scope of land economics more interrelation is desirable. In this respect the few pilot studies that we have made suggest that fruitful attention might well be given to the economics of forest, mineral, recreational, wildlife, and suburban land uses. I am particularly interested in this last problem because observation leads me to believe that the widespread development of rural-urban fringe areas in some of our states has given rise to the most important single land use problem that we face in many areas.

Further Integration of Work

Turning now to the problem of integrating the work within our field, I feel that we have a real opportunity for accomplishment. We are not a tight little group; and with workers scattered in many areas and many agencies, there has been a tendency for many land economists to go their own way. If somehow we could get together on our objectives and in our research planning, it should be possible to avoid duplication of research. At the same time it should be possible to organize a more systematic campaign to provide answers for whole areas of problems rather than for a host of scattered and isolated issues.

In this respect, we need more discussion sessions for land economists. We have had some workshops on land tenure, but we need to have sessions organized on a broader basis. There should be more opportunity and encouragement for land economists to get together and thrash out their particular problems. Many of the concepts and working tools used by these workers should be examined and discussed. Consideration also might well be given to research techniques and approaches, and to the problems encountered in teaching and extension. Another problem that should be considered centers around the adequacy of our graduate courses and programs.

Too little attention on the whole has been given to the teaching and extension aspects of land economics. I do not propose to say much here regarding land economics extension. As most of you know there isn't a great deal of organized extension work in land economics—and most of what there is exists incidental to work in public policy or farm management.

So far as teaching is concerned, I have the feeling that there are far too many institutions in which the course in land economics is treated as the proverbial stepchild. More emphasis is needed on the employment of trained teachers, the presentation of better courses, better integration of teaching materials, and in many institutions enlargement of the appeal of the courses. Not only should a course in land economics be recommended for most, if not all, agricultural economics majors, it should be recommended for other students of agriculture, for majors in forestry and conservation, for prospective county agents and vocational agricultural teachers, and for numerous students in the social sciences.

Methodological Issues

The problem of methodology is a ticklish and persistent one. We apparently are living in an age of increasing emphasis on mathematical techniques in eco-

nomics research. It is possible that many of our workers are being left behind. Yet it appears that many of them are doing a highly acceptable job with old tools. The question is how far should we go in insisting upon the development and use of new tools of analysis. I submit that in land economics as in other fields we have an opportunity—indeed we have a responsibility—to try out new approaches and to give wide acceptance to those new tools that prove both acceptable and useful. We should give more attention to new developments in economic theory, and to the potential uses of mathematical, statistical, and other methodological tools. In accepting these new developments, however, it is highly important that we not be carried away by the sense of certainty that often comes with the use of a mathematical formula. We have a responsibility never to ignore the value of good horse-sense, never to forget that our assumptions should be realistic and have relevance to the conditions of real life, and never to forget that in most cases our research is of little value if we cannot communicate our findings to others in a language that they understand.

Along the lines of methodology, we face an additional problem in the further development and use of the institutional approach as a supplement to the tools we draw from more formal economics. The improvement and refinement of this approach represents one of our major challenges. It will probably call for more ingenuity and more skillful handling than the application of many other methodological approaches. Yet the effort expended in this direction will prove eminently worthwhole if it contributes further to our understanding of the factors and forces that effect the economic behavior of man.

Conclusion

In conclusion, I too have probably given you more a cursory than a critical survey. But in the midst of my remarks you will no doubt denote a personal feeling on my part that land economics is in fairly good shape, that we have numerous problems to work on, and that we have the willingness to face the challenge of the future.

DISCUSSION—MARKETING

ROBERT L. CLODIUS
University of Wisconsin

These comments will be divided into two parts. Part I is a review of some of the work in marketing and Part II is a critique of this work. Major emphasis is placed on the critical part of this survey.

Review of Marketing

New developments have occurred in marketing in the last 10 years. Advances have been made in the use of more engineering and technical economic concepts, use of more elaborate statistics and in the inauguration of refresher studies and workshops. The decade has also been characterized by new subject matter areas and a reemphasis on certain older areas. On the whole, however, it appears that most marketing research and the literature are going along pretty much as usual.

Of the cases of research making use of engineering and technical economic

concepts only a few can be cited. They include Bressler's studies on "economies of scale,"[1] Nicholls' study of labor in meat packing from the production function approach,[2] and the series of studies of California packing house operations.[3] Engineering principles continue to play a role in studies of the physical facilities of terminal markets[4] in studies of such things as checkout counters, floor layouts, new packages, new processing, and so on. All have made their contributions to marketing in the last decade.

Marketing economists have also made increasing use of statistics during this contemporary period. Researchers use regression and other techniques to test the validity of hypotheses concerning the relationships among variables. They use analysis of variance, tests of significance, and various kinds of estimates. Sample design based upon the mathematics of statistics is being used increasingly to improve the quality of estimates and to state the errors associated therewith. In the field of market price analysis the simultaneous equations approach identified with the Cowles Commission is taking hold in some of the work by Karl Fox and R. J. Foote.[5] Despite its logical elegance there are still those who have reservations regarding its usefulness.[6]

Another contribution to marketing has been the National Marketing Research Workshop. These workshops have been held annually since 1949 on both general and specific topics—efficiency, market demand and product quality, pricing and trade, and so on. Each work group considers the current state of research and research tools available and reports to the workshop as a whole.[7]

It is unfortunate that the work groups are not more explicit in specifying the problems on which marketing people should be working. Perhaps closer liaison between research and extension people would be a means of getting a clear-cut formulation and statement of what needs to be done. In any event, at least in marketing, these workshops help meet the need for a training program that was mentioned by the Committee on Agricultural Economics of the Social Science Research Council. Perhaps these workshops are the reason that Mr. Wells did not consider this a "neglected area" in agricultural economics.

A comprehensive survey of the research activities of the U. S. Department of Agriculture was made in 1950.[8] A review of this in marketing indicates 27

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[1] R. G. Bressler, Jr. *Economies of Scale in the Operation of Country Milk Plants*, New England Research Council and the U.S.D.A. cooperating. 1942.

[2] Wm. H. Nicholls, *Labor Productivity Functions in Meat Packing*, University of Chicago, Chicago. 1948.

[3] *Efficiency in Fruit Marketing*, Reports 1-8 Giannini Foundation of Agricultural Economics, Mimeographed Reports 127, 128, 131, 138, 141, 142, 149, and 153, May 1952-June 1953. California Agricultural Experiment Station.

[4] As an example of this type of study, see C. J. Otten, S. D. Clark, A. B. Lowstuter, A. L. Owen, N. G. Paulus, P. S. Richey, and J. I. Kross, *The Wholesale Produce Market at Milwaukee, Wisconsin*. U.S.D.A., P. and M.A. and University of Wisconsin, Madison, Wisconsin, January 1950 (mimeographed) and *Supplement*, May, 1953.

[5] One example is R. J. Foote, J. W. Klein, and M. Clough, "The Demand and Price Structure for Corn and Total Feed Concentrates." U.S.D.A. Technical Bulletin 1061.

[6] Herman Wold and Lars Jureen, *Demand Analysis*. Wiley, New York, 1953. especially Chapt. 2.

[7] These reports are published in mimeographed form by the Agricultural Research Administration, U.S.D.A.

[8] Committee on Agriculture of the House of Representatives, 81st Congress, 2nd Session, *Research and Related Services in the United States Department of Agriculture*, vol. I-IV, Dec. 21, 1950. Government Printing Office.

subject matter areas involving over 220 line projects. Most of these subject matter areas have been matters of interest for many years. The relative newcomers are general economics of marketing, consumer preference work, motion and time studies of labor operations, prepackaging of perishables, marketing programs with State Departments of Agriculture, improving merchandising and handling at wholesale and retail, and educational and demonstrational work in marketing.

As a result of the Research and Marketing Act in 1946 there has been an upsurge of interest and research in several of the older fields. These are cost and margins studies; measurement and analysis of food supplies and consumption; price, supply, and consumption analysis for farm products; development of adequate physical market facilities; and educational work on improving marketing methods.

With a few exceptions the published literature on agricultural marketing caused little controversy and was generally acceptable in the tradition. One dissonant note in this harmony was sounded in 1945 by F. L. Thomsen in his "A Critical Examination of Marketing Research."[9] Wm. H. Nicholls in 1948 was perhaps not quite so blunt but equally critical of current work when he called for a "Reorientation of Agricultural Marketing and Price Research."[10]

A Critique of Marketing

Mr. Wells stated that marketing "is still the field in which agricultural economists are least sure, the field where they are most inclined to get lost in an evergrowing mass of detail." Two hypotheses for this are offered. The first hypothesis is that many agricultural economists in marketing are not sure and do get lost because they apparently do not use a blueprint, a map, or a general framework of analysis in approaching their subject matter.

Where is this analytical framework to be found? In good part it can be found in the parent discipline which is economics, but many features are still to be created. From economics as a base what reorientation of marketing is indicated?

In the first place economics emphasizes that the unit of analysis is the social or human element organized into households, plants or firms, and their appropriate aggregates. The results of marketing research are extended to consumers and households, to marketing plants and firms, therefore why don't marketing researchers use the economic theory of consumers and households and the economic theory of plants and firms as analytical models? Furthermore since research results must ultimately be meaningful to human beings in society, why not incorporate the human element into models applicable to marketing? This is the real substance of saying that marketing and agricultural economics are applied fields. They apply to human beings and human behavior.

An economic orientation of marketing permits appraisal of many contemporary efforts in the field. From the viewpoint of the economics of consumption one person finds that preference analysis is a "pallid offspring" of the theory of consumer's choice.[11] I assume this is so because economics, hence marketing, is a behavioral science, and until the relationship between preference or desire and behavior is known, preference analysis is of suspect usefulness.

[9] *This Journal,* November 1945.

[10] *This Journal,* February 1948.

[11] Ruth P. Mack, "Economics of Consumption" in B. F. Haley, ed., *A Survey of Contemporary Economics,* vol. II. Irwin, Homewood, Ill., 1952, p. 72.

With respect to other micro-economic problems in marketing, economics offers the theory of the firm which can provide a point of departure as pointed out by George Mehren.[12] Today the theory of the firm has been broadened to include much more than the mechanical combination of factors and maximization of profit and should prove to be even more useful.[13]

From the viewpoint of the theory of the firm the traditional "functional approach" to marketing becomes questionable for economic analysis except as a description. Marketing is performed by human beings, *not by functions*, and the entrepreneur has the leading role. These human activities are carried on in a legal and economic unit known as a firm. The firm receives inputs of factors, combines them, and produces outputs of goods and services. Prices are determined (or established) at both ends of the production process—the factor side as well as the product side.

Another contribution from economics which could be used in place of the traditional is the market structure approach, an extension of firm theory to groups of firms. The price and output results in a given market are viewed as having been established by the total of attributes which characterize this market. In the broad sense these structural characteristics include number and size distribution of firms, product characteristics and their interrelationships, conditions of entry, and so on. Market structure affects the behavior of firms, and they in turn attempt to alter the structure of the markets in which they buy and sell.

Costs and margins work is a logical counterpart of the functional approach to marketing. When viewed from an economic firm approach however, much traditional costs and margins research seems to be devoid of economic significance as pointed out by Hoos,[14] and I agree.

Time is too short to permit criticism of the other areas of traditional marketing work which suffer somewhat when viewed from economic analysis. Certainly the single commodity approach and traditional grades and standards research could be criticized, as well as the undue emphasis on efficiency in marketing research.

Use of economic criteria seems to make for a harsh appraisal of contemporary marketing work. Not all is lost. In some areas there is a degree of approval. One example would be of certain types of descriptive research. By and large our economic system responds to individual enterprise. Americans are free to allocate their resources as they may choose. A condition for successful operation of free choice is reasonably good knowledge. Any improvement in the knowledge of consumers, handlers, and producers made by market research, disseminated by extension and informational activities, can result in a more perfect operation of the enterprise system, and a more effective allocation of resources in response to this freedom of choice.

The production approach to marketing, in vogue in certain marketing circles, is also consistent with the highest traditions of economic analysis. It parallels the "new look" that farm management has taken on in recent years.

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[12] George Mehren, "The Theory of the Firm and Marketing." R. Cox and Wroe Alderson, *Theory in Marketing*, Irwin, Chicago, 1950.

[13] *Survey of Contemporary Economics*, vol. II, *op. cit.* A. G. Papandreou, "Some Basic Problems in the Theory of the Firm."

[14] S. Hoos, "The Behavior of Marketing Margins on Citrus Fruits," *Journal of Farm Economics Proceedings Number*, Dec. 1952, p. 915.

Some added work is necessary, however, further to incorporate the mechanical and engineering and technological factors into the human and social element which is controlling in the decision making process.

There is always a danger that marketing people will be carried away with the wonders to be accomplished by work simplification, motion and time studies, the mechanics and the technology of marketing generally. While important they should not be overemphasized in agricultural marketing work.[15]

Placing the engineering and technical aspects of economics in proper perspective and letting the human or managerial element shine through can also pave the way for some interesting future work. Direct questioning of entrepreneurs perhaps can provide more insights into the operations of marketing firms and the expectational configurations of business men than the most ingenious budget or other approach.[16] After all look what direct questioning did for Dr. Kinsey! In addition here is where marketing economists can profit by collaboration with other disciplines in the social sciences—social psychology, sociology, cultural anthropology and so on.

Reference to the science of economics will not solve all the ills of marketing as there are certain micro-problems and certain macro-problems for which economics does not provide great assistance. At the macro level of analysis little is known regarding the market relationships existing between the agricultural and nonagricultural sectors of the economy. However, the writers on the subject in the last few years have attempted to use the aggregative concepts, variables, and economic models of general economics.[17] It is primarily in the area of resource allocation that there are no macro-economic theories available for use by agricultural economists. Yet the need is great.[18] A wise use of marketing research funds might be the development of appropriate aggregative theories in the market sector of the economy. Such theories could contribute much to the analysis of the "neglected areas" pointed out by Mr. Wells—particularly what he called "price structure." Is it unheard of that a marketing man should be expected to make significant contributions to economic theory which might further assist in the solution of other problems?

I was somewhat surprised that Mr. Wells did not include study of agricultural development as one of the underdeveloped areas in agricultural economics. Certainly the marketing part of it is neglected. Reason implies that marketing

[15] For the observations and opinions of others see H. R. Wellman and G. L. Mehren, "Some Considerations of Research in Marketing Horticultural Products," *This Journal*, Feb. 1946, p. 170, and Fred Winter, "Observations of Our Workshop" in *Marketing Margins and Efficiency*, Marketing Research Workshop, July 9 to 19, 1950, Purdue University, U.S.D.A., A.R.A. (mimeographed), p. 176.

[16] Hans Staehle, "The Measurement of Statistical Cost Functions: An Appraisal of Some Recent Contributions," *American Economic Review*, June, 1942, pp. 331-332, reaches this same conclusion with respect to statistical measurements of cost following Joel Dean.

[17] As examples see Trygve Haavelmo, "The Interdependence Between Agriculture and the National Economy," *This Journal*, Nov. 1947; Karl Fox and Harry C. Norcross, "Agriculture and the General Economy," *Agricultural Economics Research*, Jan. 1952; H. R. Wellman and G. L. Mehren, "Some Theoretical Aspects of Agricultural Price Policies and National Employment," *This Journal*, May 1946; Willard Cochrane, *An Analysis of Farm Price Behavior*, Pennsylvania State College Progress Report No. 50, May, 1951.

[18] S. Hoos, "Implications of Aggregative Theories for Agricultural Economists," *This Journal*, Nov. 1949.

should be an important feature of development yet almost no research is being devoted to it. This is also another example of where economics does not as yet make great contributions to analysis of the problems. However research by agricultural economists might make a contribution to economics and hence provide a broader basis for inquiry. Even as in most research the necessity for interdisciplinary cooperation is especially evident here.

The hypothesis here presented that marketing needs more use of economics and economic theory is not a new one. Even members of the American Marketing Association have been doing much "soul searching" on this score in recent times.[19] They do not appear to be overjoyed with their present work.[20] Part of this revolution from the past has evidenced itself in two interesting textbooks, new in the past two years, using large doses of economic theory.[21]

Finally, I wish to suggest that this second hypothesis is related to the first. One of the major reasons for marketing researchers getting lost, for being unsure, and making a poor showing in some areas of marketing in the last decade is that much of the research is not oriented to genuine problems.

To be genuine a problem need not be confined to a so-called "practical" application for a producer, middleman, or consumer. Genuine problems in marketing are faced by the theoretician, the teacher, and the administrator as well. Marketing resources need to be allocated to all of these problems in some kind of appropriate balance.

However, the resource of market research talent has been allocated apparently according to orthodox economic principles—where the money is. And there always seems to be money, and industry approval, for the "practical" application. Hence there is a proliferation of research on marketing carrots in Wyoming, tomatoes in Georgia, green beans in New Mexico, and so on because a person could always get money for so doing. However, as with many other things, spot prices are not always the best guide for resource allocation. The valuations for the use of scarce research talents should be in terms of problems—situations where a solution would be a contribution to human use and enjoyment.

Other criticisms could be made—of graduate and undergraduate instruction, perhaps, and certainly of the stilted prose of most of our publications. Even without this, I hope that I have discharged in part my responsibility in surveying contemporary marketing critically.

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[19] See Reavis Cox and Wroe Alderson, *Theory in Marketing*, Irwin, Chicago, 1950, and the articles by Bartels, Boddy, Brown, and Bronfenbrenner in *The Role of Economic Theory in the Teaching of Marketing*, Round Table Session, American Marketing Association, Chicago, Dec. 1950. College of Business Administration, University of Georgia, 1951 (processed).

[20] As an example the article by John E. Jeuck, "Marketing Research—Milestone or Millstone?" *Journal of Marketing*, April 1953.

[21] Joel Dean, *Managerial Economics*, Prentice-Hall, New York, 1951, and Leonard Doyle, *Economics of Business Enterprise*, McGraw-Hill, New York, 1952.

RECENT DEVELOPMENTS IN METHODOLOGY

Chairman: G. B. Wood, Oregon State College

APPLICABILITY OF RECENT DEVELOPMENTS IN METHODOLOGY TO AGRICULTURAL ECONOMICS

FREDERICK V. WAUGH
Bureau of Agricultural Economics

RECENTLY I spent an evening reading some of the literature dealing with certain refined methods of statistical analysis. I found it hard going. So as an antidote I read Ogden Nash before going to bed. It was a strange mixture, and not conducive to sleep. My thoughts gradually settled down to the following:

PROFESSOR TWIST

I give you now Professor Twist,
a super-social scientist.
His learned essays on demand
are full of language strange but grand.
He never would confuse endogenous
with predetermined or exogenous.
With mathematics irrefutable
he almost unscrews the inscrutable.
But I confess it seems an oddity,
he never studies a commodity.
Like wheat, or corn, or hogs, or rice,
and helps us see what makes its price.

Post scriptum:

Resemblance between Professor Twist
and any known economist
In Government or halls scholastic
is, I wish to state, stochastic.

This jingle was not meant to be entirely frivolous. It has a serious moral: *New methods of economic research are useful if, and only if, they help us solve real concrete problems.*

Of course, a new method may be *potentially* useful before it has ever been applied to a real problem. Of course, we need pure theory and fundamental research. The imaginative economist can find many intriguing ideas in theoretical papers published in the *Annals of Mathematical Statistics* and in *Econometrica.* Some of these ideas, at least, are likely to be potentially useful. But the sole test is whether they do, or do not, provide reliable answers when applied to real problems. The most elegant method in the world will, and should, be neglected if more reliable or less ex-

pensive answers to our problems can be found with other techniques which may appeal less to the mathematician. In many cases, the economist will find that a simple graphic analysis gives him a better understanding of a problem than he could get by refined mathematical tricks. The best method is the one which gives reliable answers, and which gets these answers as easily as possible.

Why did multiple-regression analysis exert such a powerful effect upon research in agricultural economics? Because Ezekiel, and many others, demonstrated that it gave reliable answers to practical problems in pricing, marketing, and farm management. The theory of multiple regression had been developed forty years before it became popular in agricultural economics.

Are there other, less-well-known techniques, which are potentially valuable? Doubtless so. Their usefulness cannot be demonstrated by literature about definitions, logic, or metaphysics. The only test is how they work in practice. And here much of the recent literature is weak, in my opinion. Fortunately there are exceptions. The economist will find recent books by Dwyer,[1] Tintner,[2] and Heady[3] especially helpful. Different as these books are, they have one thing in common. They each discuss recent developments in analytical technique, and show how to apply these techniques to concrete problems. In my opinion, we need many more books and articles like these, which not only discuss the principles of new techniques, but also show how to apply these principles to real numerical problems.

I have neither the time nor the ability to discuss here very many of the important recent developments in technique. Instead of trying a comprehensive catalogue, I shall concentrate upon a few techniques which seem to me to have great potential value, but which have not been used much by agricultural economists.

Sampling

There is still plenty of room for new applications of probability theory to problems of agricultural economics. True, modern techniques of sampling have already revolutionized the taking of field surveys. Here the Division of Statistical Standards has done us a real service by insisting on probability sampling wherever it is at all feasible.

But the principles of probability sampling apply to other problems, in addition to that of making surveys. Take the problem of inspecting farm

[1] Paul S. Dwyer, *Linear Computations,* Wiley, New York, 1951.
[2] Gerhard Tintner, *Econometrics,* Wiley, New York, 1952.
[3] Earl O. Heady, *Economics of Agricultural Production and Resource Use,* Prentice-Hall, New York, 1952.

products to determine their quality, or grade. It is neither feasible nor necessary to inspect every potato in a carload, nor every fiber of cotton in a bale. What kind of sample, and how large a sample is needed? A few recent studies suggest that modern research on these problems might lead to more efficient techniques of inspection.

The techniques here are based upon the mathematics of probability, including sampling from finite populations and sequential sampling. The mathematical principles have been set forth in detail. But only recently have we had practical applications to the inspection of farm products.

I recently read two manuscripts from California,[4, 5] dealing with inspecting fruit as it is received in the warehouse. Each individual grower is paid according to the quality of fruit he delivers. Apparently a common practice is to keep each individual grower's crop segregated, and to inspect it all. This doubtless gives the grower a feeling of complete fairness since it completely eliminates sampling error. But it is also expensive. The California economists show that less expensive methods of inspection would assure a probability of, say, 0.95 that the sampling error would be no greater than any preassigned number, say 1, 2, or 5 percent.

The procedure is based upon well-known principles of probability. Fairly simple formulas have been worked out to determine how large a sample would be needed to give a specified degree of accuracy in grading small, medium, and large crops. An interesting by-product is the fact that even for an infinitely large crop a random sample of 9,604 apples, oranges, or olives, would give 95 chances out of 100 of an error of less than 1 percent. If we were satisfied with an error of 2 percent, 2,401 fruits would do it. Or with a 5 percent tolerance, a random sample of 385 fruits would be enough. Note that these are not bushels, nor pounds—they are individual apples, oranges, or olives.

Of course, it would be difficult to obtain a truly random sample of a crop which was delivered over a period of several weeks. The quality might vary considerably over the delivery period. Also the price differentials for quality might change significantly. For these reasons, it may often be necessary to estimate the quality of each grower's crop in each week, or even each day. In such cases, the desired degree of accuracy can be obtained by inspecting smaller samples. In general, the smaller the amount of fruit delivered by a grower in the inspection period, the smaller the necessary size of sample.

The California reports give tables indicating the number of fruits to

[4] R. G. Bressler and B. C. French, *Economy and Accuracy in Accounting to Growers for Fruit Received at the Packing House,* not yet published.

[5] G. R. Sitton and L. L. Sammet, *Packing, Assembling, and Grading Olives,* not yet published.

inspect from crops (or deliveries in the inspection period) of varying size in order to assure varying degrees of accuracy. They estimate that those plants which practice the "separate-lot" system could reduce their cost of inspection by 40 percent by using the sampling system.

Large manufacturers have found that *sequential* sampling is a profitable technique to use in quality control. It may also find a practical place in the inspection of farm products. A recent Connecticut bulletin[6] suggests that a sequential sampling procedure be used to determine the bacterial count in milk. The authors accept the Connecticut standards of bacterial count as the basis for accepting milk as Grade A, or as Grade B, or for rejecting it as unfit for human consumption. They attempt only to work out an inspection system that is economically sound.

The problem might be described as follows:

The health authorities have a given budget to pay for milk inspection. They want a system which will minimize (a) the amount of poor milk which is accepted, and (b) the amount of good milk which is rejected. To do this, they need a quick, inexpensive way of rejecting milk which clearly fails to meet the standards, and of accepting milk which is definitely above requirements. Then a much more detailed analysis can be made of all borderline milk.

The bulletin outlines a possible sequential procedure for handling this problem. Apparently such a procedure could either increase the accuracy of milk inspection under a given budget, or could do as good a job as is now being done at less expense.

Design of Experiments

Experimental work in economics has been rather limited. The agricultural economist naturally is interested in such experimental work as that dealing with the effects of fertilizer upon crop yields, and with the effects of animal feeding upon the output of meat, milk, and eggs. These studies do not deal directly with economic problems, but they should give the economist the basic information he needs concerning production functions.

Sometimes the agricultural economist finds that the information given by these experiments is not fully suited to his purposes. Sometimes he can suggest changes in the nature and scope of physical-science experiments to get information which is more useful in economic analysis. Some of the economists who have helped in this regard are the late Dr. W. J. Spillman, Einar Jensen, and Earl O. Heady. Much more work is needed in this area.

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[6] M. E. Morgan, P. MacLeod and E. O. Anderson, *A Sequential Procedure for Grading Milk by Microscopic Counts*, Storrs (Conn.), Agr. Exp. Sta. Bull. 276, April 1951.

The farm-management specialist and the marketing economist have the analytical tools to determine the most profitable adjustments if they know not only the prices to expect, but also the changes in output which would result from various possible combinations of inputs. But often they find that existing experimental results are not fully adequate to test the profitability of adjustments to be analyzed. In the recent debate between Heady and Mighell,[7] for example, I take it that they both agree that we need experimental data giving the response of dairy cows to a wider range of combinations of roughage and concentrates than has been covered in the past.

On matters of this kind, the agricultural economist must obviously work with specialists in such fields as animal nutrition and agronomy. In a similar way, marketing economists need to work with the engineers to develop useful input-output relationships in the field of processing. I hardly need to remind you that much has been done along this line by Bressler, Paulson, Nicholls, Crow, and many other economists. But there is more to be done in this field, and sound principles of experimental design will help give us more accurate, and less expensive, results.

In the field of marketing and prices, we have done very little with experimental design. The agricultural economist in most cases has taken the fatalistic view that he has no control over prices, nor over marketing methods and practices. He is rather an observer who notes whatever variations happen to occur, who tries to understand the relation of one variable to other variables, without trying to monkey with any of them. Probably this will always be true of the bulk of our research in prices and marketing.

But even here there are potential uses of experimental design. Food processors, distributors, and advertisers do a considerable amount of experimenting. They try out new products, new packages, and different promotional stunts. From a research point of view, these experiments are usually poorly designed, and the analysis of results is often faulty. The economist could suggest more efficient designs for such experiments—that is, designs which would give more accurate or less expensive, information about the profitability of changes in marketing. Many farm economists shy away from the field of market development, or promotion, as if there were something unholy about it. I believe that this is unfortunate. The agricultural economist can help build a scientific basis for market-development programs which can benefit both farmers and non-farmers.

[7] Ronald L., Mighell, "What Is the Place of the Equal-Product Function?" *This Journal*, Feb. 1953. Earl Heady, and R. O. Olson, "Mighell on Methodology," and R. L. Mighell, "A Further Note," etc. *This Journal*, May, 1953.

A recent series of papers by Brunk and others[8] at Cornell discusses the use of experimental design in agricultural marketing research, and report the results of recent studies. Houseman[9] and Burrows[10] of BAE have recently discussed some of the possibilities of this technique. Godwin[11] of Florida has reported an interesting demand study carried out by controlled experiments in which retailers varied their prices of oranges according to a specified design.

So far, we agricultural economists have made very limited use of controlled experiments—especially in the field of prices and marketing. This technique is not a panacea which promises easy answers to all our problems. But it deserves much greater use than it has yet had. Wherever industry is willing to finance its own experiments, or wherever industry is willing to cooperate with public agencies who can reimburse them for the costs of the experiments, the economist and the statistician should be able to help design an efficient study.

As Brunk said at a recent Marketing Research Workshop, "the controlled experimental method is not a complicated, slow, and expensive technique but, quite to the contrary, it is a simple, fast, and inexpensive research method." Theoretically, at least, this is true. It will not be demonstrated by writing more literature about Latin squares, rotation, and the principles of variance and covariance. Much good theoretical literature is already available. What the research man needs most is a few studies which demonstrate that these principles are useful in answering practical and important questions. Perhaps a still greater need is to convince the experimenters (including retailers) that money spent for experiments designed to measure the effects of a specific merchandising practice on a single product might perhaps be better spent measuring effects of factors affecting total net revenue, even if this should require the joint efforts of competitive marketing agents.

Consumer Panels as Basis for Demand Research

Agricultural economists have pioneered in statistical studies of demand. They have made two different kinds of studies. First, they have studied time-series to find relationships between national supply, national average

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[8] Max Brunk, B. A. Dominick, and P. L. Henderson, *Methods of Research in Marketing*, Papers 1, 2 and 3, Cornell Univ., 1951 and 1952.

[9] E. E. Houseman, "Sampling Methods in Marketing Research," *Agricultural Economics Research*, BAE, July 1950.

[10] G. L. Burrows, "An Experiment in Marketing," *Agricultural Economics Research*, BAE, October 1952.

[11] M. R. Goodwin, *Customer Response to Varying Prices for Florida Oranges*, Univ. of Fla. Agr. Exp. Sta. Bull. 508, Dec. 1952.

price, and total spendable income of consumers. Second, they (with the home economists) have analyzed family-survey data to find how consumption varies from family to family at a given time, and to discover how these variations in consumption are related to variations in income, in size and composition of the family, and in other characteristics. The research techniques used in these two groups of studies have been discussed often (sometimes heatedly) in the proceedings of this Association.

But right now at least three large demand studies are attacking demand in a different, and more fundamental way. And these studies must use many new techniques. Michigan State has set up a consumer panel which is providing detailed records of food purchases and expenditures. Harvard is now completing an RMA contract under which they have obtained detailed records of meat purchases during the past year. California and the BAE are analyzing data on purchases of citrus products obtained from a national consumer panel operated by the Market Research Corporation of America—also an RMA contract.

These studies give us a new kind of data, and may give us very important new insights into the factors affecting demand. In all these cases, most of the work so far has been in setting up the panels, getting records, and tabulating information. As far as I know, however, no demand analyses have been completed. This Association and the American Statistical Association will hold a joint session next December in Washington, D.C., at which Messrs. Kuznets and Foote will tell about the citrus study. Ayers Brinser will report on the Harvard meat study, and Professor Quackenbush will discuss his work on the Michigan food diaries. I am hoping that these four men will tell us a good deal about techniques of analysis, and that they will be able to give us at least a few preliminary findings. In view of this, I shall make only three observations.

First, the consumer-panel data for the first time give us the basis for a more nearly complete analysis of demand than can be made with aggregative data. In the past, we have usually studied one cross-section of a three-dimensional surface. We have either considered variations in national totals over a period of time, or else we have analyzed variations from family to family at a given time. This has led to many confusing results. For example, the "income-elasticity" for food as obtained from family surveys is sometimes considerably different from that obtained from time series. The consumer-panel data should give us a much better insight into income elasticity, price elasticity, and the various cross-elasticities. It should help us see demand in at least three dimensions, and perhaps more.

Second, the statistician using consumer-panel data is confronted with problems which are very different from the typical problems in time-

series analysis. In the case of time series, the statistician working with annual data is lucky if he can find twenty-five observations that can be considered in the same universe. In the case of the citrus study we have data covering 4,500 families over a period of 38 months. We have available more than 170,000 observations. Each observation includes several variables, for example, purchases of fresh oranges, of canned orange juice, of frozen concentrated orange juice, and of several competing foods. We want especially to study competition between the several foods, which means computing several million cross products and solving some large sets of equations. Here we will not be embarassed by the lack of data, but we will have a real problem of handling an enormous mass of data efficiently. A complete analysis of this material may require the use of an electronic computer.

Third, the panel data are time series, and typically cover only short periods of time. Predictions based upon studies of these data may be less reliable than predictions based upon longer series of aggregative data. I expect that some of our multiple correlation coefficients will seem very low to some of you who have worked with short time series. But I also expect that the elasticities and cross-elasticities may prove to be highly significant.

Structural Analysis

The technique of structural analysis may open up a big important field of economic research. When we want a single estimating equation, multiple correlation and regression are the appropriate tools. If we want simply to estimate, or forecast, the price of hogs, we can use an ordinary regression equation with the price of hogs as the dependent variable, and with such independent variables as the number of sows to farrow, the supplies of feed, and some measure of consumer income.

But no single regression equation can describe a mechanism (or structure) as complicated as the economic system. Nor can it adequately describe any important segment, such as the economic structure of the livestock-feed economy. To do this, we obviously would need several demand equations, several supply equations, and several equations describing the relationships involved in transportation, processing, retailing, and so on. It is important to note that these equations may not be independent. In such a case, if we determine each equation separately by the usual least-squares process, we get answers that are inconsistent and biased.

Haavelmo showed us a theoretical way out of this impasse. His pathbreaking work in theory has been followed up by Koopmans, Marschak,

and others in the Cowles Commission. It is explained in detail in two monographs of that Commission.[12]

The theory and the mathematics of structural analysis have been thoroughly explored by very competent persons. The necessary and sufficient conditions for identification of the structural equations have been developed, and must be accepted, just as we accept any proven fact in mathematics.

Yet until recently, at least, this important theoretical development has had little impact upon statistical research in economics. Most of the literature in this field has been highly abstract, dealing with refinements of mathematics and with the intricacies of logic and metaphysics. Until recently, I have known of only two[13] econometric studies in this field; that is, studies that combine economic theory and mathematics with actual statistical verification and measurement. Not all economists are convinced of the soundness of the results in these two cases. Further practical applications are clearly needed to test the usefulness of structural analysis.

Fortunately, there are now signs of real progress. Glenn Johnson[14] has published an analysis of the structure of tobacco markets. Karl Fox[15] has made several studies of the demand and supply structure for farm products. And Hildreth and Jarrett[16] have completed a study on the structure of the feed-livestock economy. I am well impressed with these recent developments. They suggest that we may again be on the threshhold of a new era in economic research that will give us new insights into the workings of the economic machine.

My personal opinion is that we will make more progress in this research if we write fewer learned essays about such metaphysical concepts as endogeneity and predetermination. Perhaps the extensive literature on these esoteric subjects has some bearing upon practical work in structural analysis, but I doubt it. In any case, I can report that I can understand the literature on this subject fairly well if I skip the lengthy arguments

[12] T. J. Koopmans, and others, *Statistical Inference in Dynamic Models*, Monograph 10, Cowles Commission.

W. C. Hood, T. J. Koopmans and others, *Studies in Econometric Method*, Monograph 14, Cowles Commission, 1953.

[13] M. A. Girshick and T. Haavelmo, *Statistical Analysis of the Demand for Food*, Econometrica, April 1947.

T. Haavelmo, "Methods of Measuring the Marginal Propensity of Consume," *Journ. of the Am. Stat. Ass'n*, March 1947.

[14] Glenn Johnson, *Burley Tobacco Control Programs*, Tech. Bull. 580, Kentucky Agr. Exp. Sta., 1952.

[15] Karl Fox, *The Analysis of Demand for Farm Products*, USDA Tech. Bull. 1081 (in process).

[16] Clifford Hildreth and Frank Jarrett, *A Statistical Study of Livestock Production and Marketing*, Cowles Commission, dittoed discussion paper, Nov. 1952.

about which variables are exogenous and endogenous, which are predetermined and which are postdetermined, which are lagged endogenous, and so on.

Come back for a moment to the simpler problem of a single regression equation. Some economists have argued that the "resultant" variable should be chosen as the dependent, and that the "causal" variables should be treated as independents. I have never understood that argument, either. As I see it, regression is a scientific, mathematical, subject. If we want to estimate the expected value of x_1 associated with given values of x_2, x_3, and x_4, the answer is given by that regression in which x_1 is dependent, and the other variables are independent. This is simply the equation which minimizes the sum of squared errors in estimating x_1. Now x_1 may be causal or resultant. It may be exogenous or endogenous. It may be predetermined or postdetermined. It may be lagged or unlagged. At least, this is how I see it. And for those who want a more authoritative opinion, I can cite the following passage from Kendall:[17]

> "In speaking of one variate as 'dependent' and the others as 'independent' we introduce what may be a source of confusion. In general, all the variates are dependent in the statistical sense, each upon the others, and in special cases may be functionally dependent. In selecting one for separate consideration and in discussing its dependence on the others, we are usually attempting to solve a problem in estimation: for given values of the other variates, what is the best estimator of the 'dependent' variate, or its central value in the distribution which it has for such values? The idea of 'given' values, that is to say, values which can be selected at will, leads to our referring to them as 'independent,' though they may be statistically dependent on one another. It might perhaps be better to use different words, but the practice is so common that we make no attempt to improve it. Once the point has been understood no difficulty arises in practice."

In structural analysis, we must, of course, deal with two or more equations at once. This is a harder problem than ordinary regression. And before putting the numbers into a calculating machine, the economist should think through the cause-and-effect relationships. In BAE, Karl Fox and Dick Foote have constructed several ingenious structural diagrams which suggest some of the interrelationships between prices, supplies, shipments, and consumption of certain farm products. Instead of drawing a diagram, the mathematician can do the same thing by writing out a number of functional equations. The diagrams or equations can be very useful in providing a tentative, qualitative theory, and in suggesting the key problems for statistical analysis.

But when it comes to setting up estimating equations, I don't see the

[17] M. G. Kendall, *The Advanced Theory of Statistics,* London, 1946, Vol. II, p. 141.

need for classifying variables according to any sort of metaphysical criterion. As I see it, Kendall's advice on a single multiple regression applies also to structural analysis. If the researcher knows which variables he wants to estimate, and if he has a model which satisfies the appropriate mathematical tests, he may as well go ahead and estimate them and give us the results. If they prove to be dependable, he has made real progress.

Economic Models Generally

What we have come to call structural analysis is only one way of establishing an economic model exhibiting the interrelationships which exist in the economy. Quesnay's "Tableau Economique" was an economic model. So are Ezekiel's "Cobweb Theorem," Colm's "Nation's Economic Budget," and Leontief's "Inter-industry Matrix." These are all quantitative models, with numbers in them. Their inventors hope that they present a reasonable facsimile of the essential features of the actual economy. And they hope that a study of these models will help us see what is likely to happen when we have a 10 percent drop in the potato crop, or when the Government collects 10 billion dollars more in taxes.

Not all of these hopes have yet been fully realized. The prediction of great unemployment after World War II was a notable flop. This mistake attracted so much attention that many economists and statisticians are rather shy about using economic models at all—at least as the basis for short-term analyses. When it comes to estimating changes in the economy 25 or 50 years from now, economists are bolder. Models have been used for such purposes by BAE,[18] by the Council of Economic Advisers,[19] by the President's Materials Policy Commission,[20] and by many other reputable agencies, in and out of Government.

Agricultural economists have long struggled with the problem of the relation between agriculture and the rest of the economy. This is an important, practical consideration in national economic policy—especially in policies relating to the support of farm prices and farm incomes. We sadly need an impartial, scientific analysis of the effects of a given farm-price-support policy. Will a proposed policy raise, or lower, the national income? Will it make the general economy more, or less, stable? In a period of industrial depression, will farm-price supports hasten, or retard, recovery?

If we are ever going to find scientific answers to such questions, it will

[18] *Long-range Agricultural Policy,* prepared by the BAE for the House Agr. Comm., U. S. Gov't Print. Off., 1948.

[19] The Economic Report to the President, pp. 80-103, Jan. 1953.

[20] *Resources for Freedom,* A Report to the President by the President's Materials Policy Commission, June 1952.

apparently be through the analysis of models. These models must be realistic; that is, some way must be found to demonstrate that the economy really does operate in the way the models indicate.

Some variation of the Leontief inter-industry model may prove to be realistic enough for this purpose. A detailed static model is available, based largely upon Census data. A 200-row matrix has been inverted, giving the basis for measuring the ultimate effects of a change in any one industry upon the other 199 industries.

The theory of dynamic models has been explored by Goodwin[21] and by Leontief.[22] If we can develop practical, realistic dynamic models of our economy, perhaps we will have the basis for scientific policies to prevent depressions and to insure a steady increase in levels of living. Whether we are intelligent enough to use the model is, of course, a different question. Remember that the Univac had the right answer very early on election night in November 1952, but the experts couldn't quite believe it, so they fed it some new data.

We need more experience with economic models before we know how far to trust them, either in forecasting an election or in prescribing a price policy for agriculture. But without doubt some kind of model will help us do better than we have ever done them in the past.

Linear Programming

Agricultural economists have long used an informal type of programming technique. John D. Black and others have used the "budget method" for many years to find profitable adjustments in farm management. The budget method is programming, but as usually practiced, it is not a very systematic method. It relies strongly on the judgment and intuition of the researcher. And there is no guarantee that the most profitable combination of enterprises will be discovered.

Stigler[23] used a more systematic method of budgeting in the attempt to find the minimum-cost human diet which met stated specifications. But Stigler did not discover all the principles of linear programming, and therefore did not quit find the minimum-cost diet.

In economic life we usually are trying to maximize or minimize some function, subject to a number of inequalities. Thus, we usually try to maximize net income, or to minimize the cost of doing some job. We are not allowed to use a negative amount of any input factor, and we

[21] Richard M. Goodwin, "The Multiplier as Matrix," *Economic Journal*, Vol. 50, Dec. 1949, pp. 537-555.

[22] Wassily Leontief, *Studies in the Structure of the American Economy*, Oxford Univ. Press, New York, 1953.

[23] George J. Stigler, "The Cost of Subsistence," *This Journal*, Vol. 27, Pp. 303-314, May 1945.

usually are not able to use more than some stated amount of land, labor, and capital in various forms.

Here, again, there have been significant developments in abstract theory, in mathematics, and in computational techniques by Koopmans, Dantzig, and others. There have been some secret applications of these techniques to military problems, and a few studies of such problems as blending aviation gasoline and routing freight cars or steamships. But as yet there have been few practical applications to real economic problems in agricultural economics. Karl Fox[24] has recently written an article on the livestock feed economy which is formally related to linear programming. Given demand functions and initial supplies of feed in each of 10 regions and the structure of transportation costs between regions, his problem was to find the equilibrium values of feed prices and feed consumption in each region and the net quantities of feed shipped over each interregional path.

At least three promising studies are now under way. Dick King and his colleagues in North Carolina are using the techniques of linear programming to determine the most profitable combinations of enterprises on various types of farms in the State. In other words, they are making a big budget study, using a systematic procedure, rather than the usual trial-and-error technique. Fisher and Schruben, of Kansas, are using linear programming to discover the minimum-cost mixed feed for animals. Preliminary results of their work will be reported in a paper[25] to be published soon in this *Journal*. The Fisher-Schruben paper goes far beyond my own feeble efforts to discover the minimum-cost dairy feed. Also Seymour Schmidt, of the University of Chicago, has applied linear programming to the problem of discovering the optimum locations and types of facilities for storing grain.

Carryover policy for storable farm products is another field in which new analytical methods are being tried. Bob Gustafson, of the University of Chicago, has adapted some recent work on inventory theory to the problem of determining optimum carryover policies for corn. His approach takes explicit account of: (1) the probability distribution of corn yields; (2) marginal costs of storing corn; and (3) the "social cost" of below-average corn supplies. "Social cost" may be measured solely by the market demand curve for corn, or special additional values can be allowed for having reserves to meet serious drouth or war contingencies. His approach does not eliminate value judgments from storage policy analysis, but it does require that they be made explicitly in advance of

[24] Karl Fox, "A Spatial Equilibrium Model of the Livestock-Feed Economy in the United States," *Econometrica*, October, 1953.

[25] W. D. Fisher and L. W. Schruben, *This Journal*, Nov. 1953.

the formal analysis. The latter seems to lead to a unique and relatively simple optimum carryover rule for any given set of storage cost and "social cost" functions.

So far most of the literature on linear programming deals with abstract theory and with difficult mathematics. To understand the technique and to evaluate its usefulness, we need more concrete applications to real problems.

Applications of programming need not be limited to such problems as mixed feeds. There should be hundreds of important applications in farm management, in transportation, in processing, in the planning of market facilities, and perhaps even in pricing. The technique of programming may prove to be as important as the technique of multiple regression. One important limit, so far, in that *linear* programming applies only to situations in which the input-output relation is linear. For example, in the case of feeds, 200 pounds of corn has twice as much of each nutritive element as does 100 pounds. But in the general case we cannot assume linearity. This complicates the analysis. But it is not too much to hope that after we have fully tested the technique of linear programming we may find it possible to do some non-linear programming.

Theory of Games

Finally, a few brief comments on the theory of games.

The Von Neuman-Morgenstern theory has great appeal to the mathematician. And intuitively it seems as if that theory would help explain the strategies of market operators. There is an obvious parallel between a poker player and a man who buys and sells farm products. Both have to pattern their own strategies upon their estimate of the opponent's strategy.

But my impression is that so far the theory of games has remained a curious plaything for bright mathematicians. I know of no research using this technique to solve practical economic problems. Even in games, as such, the main practical result seems to apply only to matching pennies.

Presumably some work in this field has been done by the military strategists. If this research is ever declassified, we may find some practical results.

In any case, a neglected field of research in agricultural economics is that of strategy. We have shut our eyes to this field too long on the assumption that agricultural markets are competitive—and that strategy is impossible in competitive markets. Actually, though, the work of Nicholls, Hoffman, and others demonstrated many departures from perfect competition. These writers, and others, have made real progress in identifying and analyzing many practical problems of strategy in such industries as tobacco, meat packing, milk distribution, and food retailing.

So far as I know, no one has used the Von Neuman-Morgenstern techniques to find the answers to these problems. Can it be done, or is the theory of games destined to be a useless toy? The only way I know is for a few competent research men to try it out.

Conclusion

The purpose of a technique of research is to help get practical answers to concrete problems. Many proposed new techniques have never had an adequate trial. Some of them probably could be extremely useful. To give them a fair trial, we need closer cooperation between the economic theorist, the mathematician, and the statistician.

Herman Southworth, who read a draft of this paper, suggested that my conclusion might be written in the same style as the introduction. I am indebted to him for the following:

Our economic methodology
    is full of fine epistemology.
But when we come to problems practical
    our theories are too didactical.
If economics is a science,
    it needs to foster the alliance
of theorist and statistician,
    with manager and prognostician;
To tie the work of mathematicist
    to problems of the market strategist.

THEORETICAL FRAMEWORK FOR THE ECONOMIC ANALYSIS OF GOVERNMENT ASSISTANCE TO RESOURCE DEVELOPMENT

Chairman: R. T. Burdick, Colorado A. and M. College

THE ECONOMIC DEVELOPMENT OF OUR WESTERN INTERIOR

T. W. Schultz
University of Chicago

I WELCOME the opportunity to examine the economic development of the West. I have long wanted to do so. I am sure that most of us find our knowledge of the economy of the West far from satisfactory. There are at hand many particular treatments, cast in the mold of the engineer, planner or administrator concentrating on a dam, an irrigation project, or a river basin; and justified in the name of reclamation, conservation or recreation. I do not wish to imply that one cannot gain some useful insights from such studies. What is lacking, however, is a general framework to fit these parts together and in doing so at least try to determine whether they are consistent one with another. There are, also, larger and more important issues, related to the transfer of resources among regions, which are always conveniently by-passed in such particular studies.

The task of representing the economic development of the West is indeed a formidable one, too big for a brief paper and too difficult to undertake on short notice. This paper is no more than a set of preliminary notes.

Lest someone be misled, let me point out that there is no received body of theory pertaining to economic development. There are some ideas about economic growth and some hypotheses to be tested, each pointing to a different way of organizing the data. Nevertheless, something can be done to improve our insights about economic development of the West, but at best it should be viewed as both preliminary and tentative.

Anyone who generalizes about the West is like one of the blind men characterizing the elephant from the impressions he gains from his particular location. The West is not only vast; it covers a multiple of economic developments. Some of these have been occurring very rapidly, far exceeding the national rate of growth. These areas have been in the limelight. Other parts of the West, however, have not stayed abreast. I shall concern myself mainly with some of the differences in the rates of economic growth in the West. I find it convenient, therefore, to separate the parts that have grown rapidly from those that have grown slowly.

The vast western interior of the United States appears to fall in the category of slow economic growth. To delineate this area, one needs to exclude those parts of Washington, Oregon and California to the west of the Cascade and Sierra Nevada ranges, the southern parts of Arizona and of New Mexico and the eastern and south-eastern parts of Texas. The area, thus delineated, comprises most of the 17 western states; it consists of about one-half of the geographical area of the continental United States; it produces about one-tenth of the national product; it may be called the *Great Western Interior.*

Slow Economic Growth

It may be useful at this point to offer a statistic or two to adorn the major magnitudes and some of the relations among them. The Western Interior, as I have defined it, unfortunately requires a major regrouping of available data because it entails the dividing of 6 of the 17 states since only a part of 6 of them belongs to this interior. I have not had time to make this statistical separation. A rough examination of the data, however, suggests that the relationships are closely akin to those revealed by the 9 Northwest states—Idaho, Utah, Colorado, Montana, Wyoming, the two Dakotas, Nebraska and Kansas. Some relevant statistics for these 9 states are readily available. During the thirties and forties, the Northwest did not stay abreast of the rest of the United States either in population or in production although in per capita income payments it rose from 78 per cent, in 1929, to 96 per cent of the national average, in 1949. In population, however, it fell from 6.0 per cent (1930) to 5.3 per cent (1950) of the U.S. total. In production it also lost some ground relatively but not as much, declining only from 5.2 per cent in 1929 to 5.0 per cent in 1949.[1]

I take it to be true that our vast Western Interior has experienced relatively slow economic growth. Yet one might well have expected quite the converse. We have had twenty years of public policy highly favorable to the development of the West and, in addition, a long decade during which the terms of trade also have been very favorable to this area. Both of these circumstances should have accelerated its growth. But these circumstances notwithstanding, the proportion of the national product which this Western Interior contributes appears not to have increased during the past two decades; instead it may have declined somewhat. Large public investments in the area have not turned the scales. Nor have the highly favorable terms of trade induced the additional production or increased the value of the product enough to give it the required growth.

[1] U.S.D.C. *Regional Trends in the United States Economy* by Charles A. R. Wardwell. Washington, 1951. See appendix Table 14, and in the text, tables 13, 17 and 2.

Why, under these favorable circumstances, has the Western Interior not advanced in total product relative to the rest of the country? It is this query to which I shall now turn.

It is possible to represent the factors which determine the position of the demand and supply schedules on which the economy of this area rests. They are, as I see them, as follows:

Demand Factors

Take first the demand. In a growing community population, taste and income may combine to shift the demand either forward or backward and, of course, the shift may occur at different rates. Farmers who produce broilers have been favored by such demand shifts compared to what has happened to wheat growers; likewise, the makers of television sets compared to those who manufacture radios; and, similarly, those trained to administer to the health of dogs compared to those skilled in doctoring horses.

To what kind of demand growth is the Western Interior geared? I would represent it as one of relatively slow growth. In sharp contrast, the Western periphery, that is, west of the Cascade and Sierra Nevada ranges, is satisfying in the main fast growing demands for products and services associated with secondary and tertiary industries and occupations. But the lot of the Western Interior is not so happy a one. It produces chiefly products and services the demands for which normally show a relatively slow rate of growth. They are of relatively slow growth because the products of agriculture and of mining have this attribute and because this area is much more heavily dependent upon these two industries than is the rest of the United States.

There is now substantial agreement among economists that the demand for farm foods in the United States, rich as we are, has a low income elasticity, in the neighborhood of .25. Livestock and its products stand on the high side in income elasticity among our foods. The agriculture of this Western Interior, despite common opinion to the contrary, is not as heavily given to the production of livestock and related products as is the rest of the country. An examination of the cash farm receipts during 1946-48, when meat was especially dear, shows 50 per cent or less of the cash farm receipts in this area were from livestock and livestock products whereas in the rest of the United States they accounted for upward of 60 per cent of total receipts.[2] On the other hand, food grains appear to be an inferior product against income (represented by a negative income elasticity); and these grains are heavily concentrated in this Interior. The war born foreign demand for U.S. food grains, also U.S. financed, of the

[2] U.S.D.C., already cited. See Table 18.

forties and again for a while after the war began in Korea, may have led many to overlook the fact that the domestic demand for wheat has been shifting to the left, despite the upsurge in population.

What about the demand for minerals? The wartime stress on particular minerals, the growing dependency of the U.S. on imported minerals, the recent developments to go far to the north and also to the south for iron ore, and the world-wide glamor of oil, have built up a belief that the demand for minerals is of rapid growth and that it is outrunning the supply. The developments of the past two decades, however, indicate that the U.S. demand for minerals, taken as a whole, is of relatively slow growth. This is one of the outstanding facts that emerges from the very valuable Paley Report.

From 1929 to 1949, the per capita disposable income rose about one-third in real terms.[3] Turning to the Paley Report, one finds that the per capita consumption of all minerals (except gold) rose only about 16 per cent during these two decades.[4]

What we have noted about the demand for farm foods and for minerals can readily be related to the economy of our Western Interior. It is three times as dependent upon agriculture as is the U.S. as a whole, that is, about 30 per cent of its production is represented by agriculture compared to about 10 per cent for the United States and in minerals this ratio stands somewhere between 1½ and 2 to 1.

This brief representation of the growth attributes of the demand of the principal products of the Western Interior raises these questions:

(1) Are the production possibilities of the Western Interior such that this sector of our national economy can take over an increasing share of the total demand for minerals and for agricultural products? If it can, the implications for its economic growth are clear enough. The experiences of the last two decades, however, suggest that these are remote possibilities, as I shall show below.

(2) Whereas the demands are of slow growth, are the supplies of these products subject to even slower growth? If this were the case, as the demand schedules shift to the right, they would intersect the supply schedules at higher relative price points. The marked improvement in the terms of trade of the Western Interior may be explained in this way. As a consequence one would expect rent payments to the more specific factors to rise relatively. But we have already pointed out that the rise in relative supply price has not increased the value of the total product of the area enough to turn the development scales.

(3) Are the resources of this area such that production is necessarily restricted to products that have demands that are of slow growth? Or, are there possibilities of producing products and services which have rela-

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[3] See Table B-10 in the *Midyear Economic Report of the President,* July, 1952.

[4] The President's Materials Policy Commission, *Resources for Freedom,* Vol. II, Table IV.

tively fast growing demands? One of the remarkable facts about the West is that some, now major, sections of the 17 western states have demonstrated their capacity to do exactly this. Communities situated in what I have referred to as the western and southern periphery of the West have found and developed such production possibilities. But public and private investments in the Western Interior have not been directed to this purpose, as I read the record. It would seem, however, that water and electrical energy are resources that could go either way.

Supply Factors

To take our bearing with somewhat more care on these issues, it will be necessary to turn to some of the more important supply considerations. Changes in fundamental factor supplies and in technology may combine to the advantage or disadvantage of a particular area and changes such as these may come about either slowly or rapidly. We know much less, however, about the factors related to economic development determining the growth of the supply than we do about those underlying the demand. I shall, nevertheless, venture some judgments about these attributes of the relevant supplies in the belief that doing so may help us see somewhat more clearly the nature of the analytical problem. Let me anticipate my conclusion. In the production of agricultural products and of minerals, the Western Interior has not been the recipient of any substantial net advantage in its growth of fundamental factor supplies either from advances in techniques of production or from other sources.

In agriculture no other major area in the United States is confronted to the same extent by a particular limitational factor in its production as is the Western Interior. Agricultural land in nearly all of the rest of the country is no longer, as it appeared to the classical economists in their era, even approximately a limitational factor in producing food. New techniques and the use of other inputs have fundamentally altered the range of production possibilities. Our Western Interior, however, finds its agriculture severely limited by the water that is (ultimately) available to it. Nor have new techniques improved the production possibilities of this area as much as they have in the rest of the United States.

One may put these issues in terms of long run relative supply prices. For agricultural products, the relative supply price does not appear to be undergoing any marked fall or rise. As the fifties unfold, all signs point to a relative supply price for farm products very much like those of the late thirties. If one takes parity to measure this relationship, it is somewhere in the neighborhood of 90 percent of parity taking all farm products together, with livestock and its products somewhat higher relative to food grains. But even this change among the supply prices of farm products is partly the result of particular legislative manipulations to which the calculations of parity have been subjected.

In the production of food and feed grains, in our Western Interior, we have virtually completed the mechanization made possible by the tractor. This technical advance lowered somewhat the relative supply price of these farm products. But it has not substantially increased the amount of such grains that this area can produce, leaving changes in weather aside. In livestock production, in both cattle and sheep, the intermountain region appears not to have gained from advances in techniques of production as have most of the other major farming areas in the United States. The feed on which these livestock depend has not experienced a forward thrust equivalent to that given to the corn belt by hybrid corn. Grassland grass in our vast interior is still genetically as it always has been ever since the cattle and sheep growers came on the scene.

In minerals the key commodities also appear to have production possibilities that indicate no substantial rise or fall in relative supply prices. One may also infer from the Paley Report that an increasing share of our domestic requirements is likely to be met by imports. Thus even if the Western Interior were to continue to supply about the same proportion of the national output that it now does, its production would come to represent a smaller part of the total domestic consumption. Turning to the past two decades, however, it appears that this area lost some ground nationally. Taking the Northwest as an indicator, its mineral output declined from 9.7, in 1929, to 8.8 percent in 1949 of the U.S. total.[5]

Thus, in representing the factors determining the position and shifts of the supply schedule, as our economy continues to grow, one may venture the inference that our Western Interior is not likely to supply an increasing share of the total U.S. demand for minerals and for agricultural products. Looking back and, once again, using the Northwest for a statistic, we find that in agriculture and mining this particular area produced somewhat less of the U.S. total output in 1949 than it did two decades earlier.[6]

Summary

In closing this exploratory paper, I wish to submit these statements and to draw these tentative inferences:

1. The economy of our Western Interior is more dependent than is the rest of the United States upon demands that have the attribute of relatively slow growth.

2. In agriculture, the new and better production possibilities, as these have been revealed during the last two decades, show somewhat less

[5] U.S.D.C. already cited. Table 21.

[6] U.S.D.C. already cited. Table 17. 13.8 per cent for 1929 and 12.7 per cent for 1949.

competitive strength throughout our Western Interior than they do in most of the other major agricultural areas.

3. As these agricultural production possibilities are realized, to satisfy the slowly expanding demand for farm products, our Western Interior is likely to find itself supplying a smaller proportion of that total.[7]

4. In minerals, the underlying production possibilities appear to have attributes similar to those within agriculture as set forth in 3 above with one major qualification, however. Recent past discoveries from oil explorations may be a more uncertain guide to what will be discovered in the near future than are prospects for new practices and better techniques of production in farming.

5. Both private and public investments (new construction) in our Western Interior have increased relative to such investments in the rest of the United States. They have been large in relation to the population and to the share of the national product contributed by this area.

6. These investments have been committed in the main to produce products and services considered under 1, 2, 3, and 4 above.

7. The western periphery of the West has been outstandingly successful in developing its economic activities to produce products and services, the demands for which have the attribute of very rapid growth.

8. If the vast Western Interior of the United States is to stay abreast or is to increase its share in the national products, new production, including the supporting investments, must be directed to activities other than agriculture and mining. There remains, however, this basic question: Do some areas within this Western Interior have a net advantage in producing such new products and services?

DISCUSSION

S. V. CIRIACY-WANTRUP
University of California

Dr. Schultz has presented an interesting study in regional analysis. The region which Dr. Schultz calls "Our Western Interior," and for which he presents data, comprises the nine states, Idaho, Utah, Colorado, Montana, Wyoming, the two Dakotas, Nebraska, and Kansas. Although Dr. Schultz does not use the clichè of "depressed area," he emphasizes that this region has fallen behind the rest of the United States in terms of increases in population and production between 1930 and 1950. He then tries to explain this disadvantage in terms of changes over time of supply and demand for the products of agriculture and mining relative to the demand and supply for other products.

In production, the disadvantage in the regional average relative to the United

[7] 2 and 3 above are not inconsistent with the findings reported in *Agriculture's Capacity to Produce,* BAE Agr. Inf. Bul. 88, June, 1952. See pages 5, 6 and 7.

States average is very small. In some important lines of production—for example, oil, gas, coal, and manufacturing employment—Dr. Schultz's region shows important gains over the nation as a whole. Of Dr. Schultz's indicators of disadvantage, only relative changes in population appear statistically significant.

The first question which may be raised in analyzing regional averages of population changes concerns the homogeneity of the region. After studying the same Department of Commerce report[1] on which Dr. Schultz bases his findings, I have considerable doubt that Utah and Nebraska and Colorado and North Dakota belong economically to the same region. I am afraid that the regional averages, which Dr. Schultz is using, obliterate two distinctive regional patterns and make the task of analysis difficult.

First, there appears a region comprising what may be called the "Mountain States"—Idaho, Utah, Colorado, and Wyoming. This region has *not* fallen behind the United States average in population growth. Two of these states—Utah and Colorado—show not only a larger than average population increase but also a positive migration balance. In spite of this, all these states had greater than average increases in per-capita income payments between 1930 and 1950. Colorado and Wyoming had per-capita average income payments in 1950 higher than the national average.

Second, there appears a region comprising what may be called the "Upper Missouri Basin States"—Montana, the two Dakotas, and Nebraska. This region *has* fallen behind the United States average in population growth and, moreover, shows a negative migration balance. On the other hand, it may be well to note that these states showed a far higher than average increase in per-capita income payments between 1930 and 1950. However, the average per-capita income payments in this region were still slightly lower than the national average in 1950—except in Montana.

From the standpoint of the country as a whole and also from that of the region, the relative loss of population in the Upper Missouri Basin is not necessarily a disadvantage. Out-migration may be regarded as an indication that the region is adapting to changes in the economic environment—that it is taking advantage of technological developments and of the opportunities of membership in a greater economic unit, namely, the United States.

I come now to Dr. Schultz's explanations—accepting for argument's sake his thesis of a regional disadvantage. I agree that shifts over time in demand and supply for products of agriculture and mining relative to the demand and supply for other products are important. I doubt, however, whether such generalizations offer a satisfactory explanation of the data which are presented. Statements about national and international demand and supply appear less relevant than a detailed study of the resources available to a region relative to other regions and changes in this relationship over time. Here again, Dr. Schultz's region is far from homogeneous. Relevant also is a study of historical and institutional aids and obstacles which may affect a successful adaptation to changes in the economic environment.[2]

Let me illustrate: Dr. Schultz's statements about the demand and supply of agricultural products are equally applicable to the agricultural resources of North Dakota and Iowa; still, there are essential differences in adaptive possi-

[1] U. S. Department of Commerce. ***Regional Trends in the United States Economy.*** A supplement to the Survey of Current Business. Washington, Govt. Print. Off., 1951.

[2] S. V. Ciriacy-Wantrup, ***Resource Conservation, Economics and Policies.*** Berkeley, University of California Press, 1952. 396p.

bilities between these two states. Development of the oil and gas resources of the Williston Basin will be of great importance for all participating states regardless of whether the forecasts of the Paley Report on demand and supply of minerals are correct. Obstacles to out-migration from the Upper Missouri Basin would be more alarming than the migration itself.

Finally, a few words about the implications of Dr. Schultz's analysis. These implications are not spelled out in the paper, but they are alluded to: Dr. Schultz always compares regional with national averages. The national average is used as a kind of parity aganist which regional disadvantage is measured. This notion of regional parity needs some comment regardless of whether the regional average is meaningful.

Parity concepts are now deeply anchored in the thinking of large sections of the population and in present institutional arrangements. This is not the time or the place for analyzing the broader implications of this situation. Agricultural economists have not given them the critical attention they deserve. Some agricutural economists have assisted in the development of the present situation. I may say, however, that it would be most unfortunate if, in addition to the established policy objectives of price and income parity, there should be established an objective of regional parity with the United States average as a base.

In connection with this notion of regional parity, the question may be raised whether public assistance to resource development should be used as a "substitute" for out-migration in leveling out regional disadvantages. Even if the possibility of such a substitution exists—and this is not a simple question—I do not believe that it should be a *primary* criterion for investments by the federal government. This applies also to water resource development in the Missouri Basin.

As suggested above, the record of the Upper Missouri Basin in adapting to changes in economic environment is good. There may be further opportunities in this direction. With respect to water resources, for example, one may think about greater development of ground water. Development of ground water is exceptionally well suited for local rather than federal initiative and for private rather than public investment.

DISCUSSION

ERNEST A. ENGELBERT
University of California at Los Angeles

Professor Schultz has examined, from the standpoint of mining and agriculture, the possibilities of resources development of our Western Interior. In doing so, he has tried to develop a useful economic framework for regional analysis. He argues that there is no adequate body of theory pertaining to economic development. With this observation I am in complete agreement. Indeed, I would go further and say that the development of resources has never proceeded upon the basis of any well-formulated theory of economic analysis. This is no reflection upon economists for no professional group has contributed more to the theory of resources development than the discipline of economics. Nevertheless American development has now reached the point where we need to reformulate some of our basic economic concepts of resources development to fit an economy which is facing, for the first time in its history, in terms of certain key natural resources, a critical stage of growth.

One does not need to be a neo-Malthusian or a congenital economic pessimist to recognize that some new variables must be introduced into the theoretical framework for economic analysis for resources development if economic theory is to have a firm basis in socio-political actions and programs. This is particularly important in connection with broad regional developments. At the risk of gross over-simplification it may be useful here as a tangential comment upon Professor Schultz' paper to briefly set forth what a political scientist regards as some of the shortcomings of much current economic analysis in this field.

1. The economic frame of reference too often assumes that the type of private or government action that is desirable follows from the analysis and determination of the economic interests of individuals and industries. This has led to an overemphasis in research and theory upon the competitive position of the business unit and its resources demands and requirements. It has been assumed that by building upon microcosmic analysis macrocosmic goals would be perceived.

This approach for resources analysis, however, is as false as assuming that society as a whole constitutes nothing more than the sum of its parts. Resources development to be sure is partly conditioned by the prevailing mode of economic enterprise and behavior, but any theory of resources analysis which only flows outward from the existing economic pattern is bound to be an inadequate framework particularly for government action.

To motivate appropriate action, an economic theory for resources development must place in perspective the strength and weakness of the overall economy in relationship to collective social demands. The position of resources in place and time takes on a much different economic character when broad national considerations are injected into the analysis. Though Professor Schultz' paper starts with an embracive approach with respect to national considerations that affect the Western Interior, the statement needs further development.

2. Much of the existing economic analysis for resources has been inadequate because the conditions underlying growth and change have not been sufficiently translated into theoretical concepts. Too many of our resources studies to date have analyzed the availability and adequacy of resources primarily in their natural state and setting or in terms of existing uses and problems rather than in terms of their transformation and convertability to other materials and products or in terms of future uses and problems. The significance of the President's Materials Policy Commission reports lies largely in the fact that it reversed the usual approach and studied the use and development of resources primarily in the perspective of economic growth and the types and quantities of materials necessary to sustain an industrial civilization.

An adequate theoretical framework for an analysis of the relationships of resources to industry growth needs to pay far more attention to projections of probable real costs for key resources and the pervasive impact of the changes in cost trends upon the overall industry structure. It likewise needs to give more consideration to the organizational capacity of specific industries to adjust to growth and development. Professor Schultz has dealt with this problem in terms of agriculture and mining but has omitted any discussion of other industries which in terms of a changing technology may, in the future, substantially alter the character of the Western Interior.

3. Much economic analysis has been deficient because it has not sufficiently taken into consideration the influence of the factors of research, invention, and

technology in the use and develoment of resources. Neo-classical theory, as a recent study by James Duesenberry and Anne Grosse has shown ("Technological Change and Dynamic Models," 1952), has primarily studied resource utilization and productivity from the standpoint of capital intensification rather than of improvement in the arts of production. Yet if anything at all contrasts the growth of the American economy from the economy of other capitalistic countries it is the extent to which we have capitalized upon applied research, invention, and technology. Now these are factors whose impact in terms of resources utilization is not neatly measured by the study of economic risk, time preferences, the availability of capital or other similar economic forces. Improvements in the arts of production depend upon such diverse phenomena as the quality of science, the fields of coverage of research effort, the diffusion of the progress of invention into the economic system, and the legal and institutional barriers to rapid technological change.

As the American economy becomes increasingly restricted by the availability and supply of key resources and the new technological and organizational methods and techniques become of relatively greater importance the neo-classical economic models will prove even less useful for resources analysis. Economic theory needs to be increasingly directed toward finding quantitative measurements for weighing the influence of research, invention, and technology upon industrial growth and trends so that the future demands upon resources can be more correctly approximated.

4. Current economic analysis studies the use and development of resources too predominantly from the standpoint of the extractive and basic producer industries and insufficiently from the standpoint of the values and preferences of resource-user industries and consumers. This approach is based upon the economic logic that the consumer's wants are adequately determined at the market place. As a result these studies emphasize the conservation and development of resources, for example, primarily in terms of the savings that may be achieved in oil extraction and refinement rather than from the standpoint of the gasoline consumption of the automobile, or in terms of more efficient production of an agricultural commodity rather than from the standpoint of product wastage that results from inadequate knowledge of consumer preferences for specific commodity grades and standards. Insofar as Professor Schultz' paper is built around agriculture and mining only, his analysis is likewise inadequate.

Moreover a theoretical framework which is built around the producer does not adequately take into consideration consumer preferences for the use and development of resources which are not measured by the economic laws of supply and demand, such as the maintenance of potentially productive areas for recreational facilities or the dispersion of population. These are the kinds of factors which will have greater impact upon the growth of the Western Interior in the future. As our society moves increasingly farther away from an economy once dominated by the extractive industries to an economy of more consumer oriented industries, economic theory will need to give more attention to the ways in which consumer preferences and values can be noncoercively guided to bring about the wisest resource utilization both nationally and regionally.

5. Economic theory has not provided a useful framework for the development of resources on a regional basis. There has, indeed, been little recognition until recently of the fact that resources developments which appear desirable

for specific industries are not necessarily the most desirable from the standpoint of the overall development of the region in which the industries are located. Furthermore, economic analysis has not adequately shown what types of economic action should be employed for regions which possess widely varying resource potentials and are in different stages of economic maturity relative to the national economy. Nor has economic theory indicated whether the national interest is best served by resources developments designed to make the regional economies more self-sufficient or more industrially specialized.

Obviously these are issues for which, in a changing economy, permanent solutions will never be found. Nevertheless the reason so much of the government-sponsored resources development within specific areas to date has been so piecemeal and inconsistent is due to the fact that no overall picture of the region's growth and development has been available. Professor Schultz' paper helps pull the Western Interior's growth into regional perspective, but more analysis of the relationships of this region's growth to the growth of other regions is obviously necessary.

6. Economic theory for resources development has not sufficiently balanced economic considerations with non-economic considerations in the decision-making process. To be sure most economists dealing with resources developments have freely recognized the importance of such factors as lack of knowledge, custom, culture, and institutions in the individual's decision-making process, or such factors as leadership, power, and security in the collective decision-making process, but instead of trying to weigh their relative importance in the economic analysis, they have usually passed over these factors as problems for other social scientists to evaluate. The wariness of economists to inject non-economic considerations sufficiently into the decision-making process has produced great gaps about the behavioral and institutional patterns affecting specific resources industries and user groups. This narrow approach has also led to some erroneous conclusions about the nature of social incentives for resources development and the responsibilities and actions of government.

The criticisms that have been levelled at economics concerning its approach toward resources development can be directed equally at other social science disciplines. The inadequacies of theories of various disciplines stem from the fact that resources problems are so pervasive that nothing less than broad social analysis will suffice.

In analyzing some of the problems of the growth of agriculture and mining in the Western Interior Professor Schultz has established a framework of analysis which breaks from some of the more conventional economic approaches. It remains for him to apply his approach to the potential industrial development of the Western Interior. It also remains for other social scientists to ascertain to what extent socio-political values and institutions can be used to foster healthy growth in this great region. Perhaps after all of the evidence is in, some of the tentative conclusions which Professor Schultz has reached about the development of the Western Interior may not appear so pessimistic.

PUBLIC POLICY FOR RESOURCE DEVELOPMENT IN THE WEST

Chairman: W. P. Thomas, Utah State Agriculture College

PUBLIC WATER POLICY FOR THE WEST*

Roy E. Huffman
Montana State College

THE development, control and use of water resources is a problem of vital concern to the western region of the United States. The problem is also important to all of the Nation. The Federal Government has evidenced a spasmodic but persistent interest in the success or failure of public policies and programs with respect to water resources. Numerous public and private groups have studied the course of public action and have made recommendations regarding future policy. Most important of these were the Fact Finders Commission of 1923-24, and the President's Water Resources Policy Commission of 1950.

That public policy has not changed easily and rapidly is evidenced by the fact that some of the recommendations made by the 1950 Commission had been made a quarter of a century before by the earlier Commission. The reluctance to change existing policies and programs, and to formulate new ones, stems at least partially from disagreement regarding the extent and nature of public participation in the water resource field. It is also associated with the notion that what is good for the West may not be good for the Nation, and vice versa.

The National Point of View

To the extent that federal funds are invested in resource development, the citizens of the Nation are entitled to expect that the expenditures will be made where the money will produce the greatest gain in net social product. This means that the location and kind of public investment should be selected from among the available alternatives. In the case of irrigation development, for example, it means that this form of land reclamation should be measured against other types of land reclamation including drainage, land clearing, and rehabilitation of deteriorated lands. We need more of the kind of analysis made by Rudolph Ulrich.[1] This study was concerned with a comparison of the land improvement costs and the resultant increases in agricultural production associated with

* Contribution from Montana State College, Agricultural Experiment Station. Paper No. 310 Journal Series.

[1] Rudolph Ulrich, "Relative Costs and Benefits of Land Reclamation in the Humid Southeast and the Semiarid West," *This Journal*, February 1953, pp. 62-73.

irrigation of the Columbia Basin Project in central Washington, and the costs and benefits associated with water control practices, clearing, fertilizer and lime on the Piedmont Plateau in Mecklenburg County, Virginia. The comparison is defensible in view of the fact that both areas involve self-contained farms and that the benefits are primarily those accruing to the farm operators. It assumes, however, that the measure of preferable public action is to be found entirely in a comparison of the cost per acre of securing increased agricultural production. It leaves out other public policy objectives of varying historical importance and future concern. The Columbia Basin development is not typical of much of the irrigated agriculture of the West. The more characteristic pattern of resource use in the West, wherein irrigated lands are integrated with other lands, makes impossible an analysis within farm unit boundaries in the traditional farm management framework.

In the same manner, the costs-benefits analysis of public resource development does not answer completely the question of what is in the public interest at the national level as contrasted to the regional, state or local level. The incompleteness of costs-benefits analysis is associated in large measure with the importance or lack of importance attributed to the secondary costs and benefits, both monetary and non-monetary, of resource development. The non-monetary factors—extra-market values[2]—may actually be measurable in money terms but not be priced in the existing market structure, or it may never be possible to subject them to more than value judgment. In either case, they are often the crux of the argument which takes place between those who are concerned with the local effects of resource development and those who take a national point of view.

Specifically, the disagreement centers around the benefits which accrue to others than the direct users of the resources. The widely accepted national point of view states that a given public investment in resource development will produce about the same amount of secondary benefits—increased business activity, support for public services, extra-market values—no matter where the investment is made. The conclusion is that any differences in such benefits are insignificant as among alternatives for public investment and that choice among the available alternatives should be based on the direct, primary benefits expected to accrue from public expenditures, and then only those which are measurable in monetary terms.

I suggest that the nature of resource distribution and the pattern of resource use in the West are such that the secondary or indirect benefits

[2] See S. V. Ciriacy-Wantrup, *Resource Conservation, Economics and Policies,* University of California Press, Berkeley and Los Angeles, 1952. Also Roy E. Huffman, *Irrigation Development and Public Water Policy,* The Ronald Press Company, New York, 1953.

of resource development, both monetary and extra-market values, are significant enough to warrant consideration in choosing among alternatives for public investment. It is the burden of this paper: (1) to describe for you the peculiar nature of western water resources; (2) to assess their importance in public water policy; and (3) to reconcile regional and national interests.

Peculiarities of the Western Region

The economic growth of the West has been materially affected in large measure by public land policies at the Federal level of government. These land policies were designed to perpetuate and protect certain values considered important to the future of the Nation. For example, the Homestead Act and other land settlement laws were designed to perpetuate the family farm. In addition, the various congressional acts setting aside forest reserves, national parks, and public grazing lands were designed to protect resources in the interest of future generations. These policies have all had a lasting impact upon the development, control and use of land and water resources in the West. The economic analyst who works with the resource problems of the West soon finds himself caught up in this web of institutional reality.

Among the several water uses, irrigation is of major importance in the West. Irrigation may serve two purposes; (1) it increases agricultural production, and (2) it adds stability to the agriculture of an area. The natural distribution of resources and the pattern of resource control and use which has evolved as a result of both natural and institutional factors makes the stabilization purpose of particular importance in the arid and semi-arid West. Discussion of irrigation development has usually centered around the question of its effects on agricultural production and the implications with respect to other agricultural areas of the Nation. Established agricultural areas have objected to competition from what they call "subsidized" production from irrigated areas. One can raise pertinent questions regarding the amount of subsidy involved in government flood control activities designed to keep water off of agricultural lands and where no attempt is made to assess the private operators who benefit. In public irrigation development the farm operators enter into a contract to repay, in theory at least, the cost of putting water on their lands.

Increased production from irrigated land is an important consideration but the relationship between irrigated lands and other lands of the West is of greater importance. The widespread integration of irrigated lands with the non-irrigated lands of the West, both within the same farm or ranch unit and with less definite forms of resource control, indicates that the whole story has not been told when irrigation development is evaluated on the basis of the increased production per acre irrigated. The eco-

nomic use of much of the range land of the West is dependent upon the complementary effect of irrigated lands which provide an assured supply of winter feed. It is a matter of area diversification rather than diversification within the line fences of a farm unit, and to consider the value of the irrigated acres apart from the whole is as unrealistic as it would be to evaluate the hay acreage of a diversified farm apart from the total of the farm operations.

The basic economic importance of water in the West goes beyond its use for irrigation. As in other parts of the Nation, the supply of water may set the absolute limit to the economic growth of an area. It is not surprising, then, that the development, control and use of water resources is a matter of the greatest concern in the West where water is more scarce than in the more humid portions of the Nation. Even in the Columbia Basin where the great Columbia River provides an abundant supply of water, questions of water policy are of prime importance because the River provides the only source of power in the region. Energy is vital to the modern economy and there are few commercial coal mines or oil wells in the Columbia Basin.[3] Support for hydroelectric power development becomes, then, not a matter associated with political alignment. It is akin to the basic importance of coal to the economy of Pennsylvania and the Ohio Valley.

By contrast, the Missouri Basin is a region where the available water supply is small relative to demand, and the important issue is control and allocation among uses. The Missouri Basin, comprising one-sixth of the land area of the United States, is a region of great distances and sparse population. In this vast area, there is great interest in the expansion of the resource base upon which commercial endeavor and public services rest. Periods of stress, particularly the drought and depression of the 1930's, made evident the fact that much of the Great Plains did not have an adequate resource base to support a profitable level of economic activity or an acceptable level of social services. It appears that there is a minimum resource base necessary to insure economic and social progress without periodic assistance from outside the area. To the extent that public investment in the water resources of the Missouri Basin can put a firm foundation under the economy of the region, both the region and the Nation stand to gain. The region will gain most directly but the Nation will gain in the increased productivity of the area and the decreased need for federal subsidy and assistance.

California and the Southwest is a region of rapid population growth

[3] Daniel M. Ogden, Jr. "Key Policy Conflicts Affecting Columbia River Development," *Proceedings of the Water Resource Development Committee of the Western Agricultural Economics Research Council*, Berkeley, California, March 2-3, 1953, pp. 97-106.

and tremendous industrial expansion. Here, more than in any other part of the West, there is widespread recognition of the basic economic importance and limitation of water. The competition for water to meet the growing domestic and industrial needs, as well as to facilitate a continuing intensification of agriculture, makes water policy a problem of major concern. The available supply is already fully utilized in most instances and much attention is focused on possible new sources of supply.

The Nation's Stake in the West

The foregoing discussion emphasizes that all of the West is much concerned about the development of its resources and that water is the key to the economic growth of the West, both past and future. The Nation has a tremendous stake in the future of the West. For the past one hundred years, the Nation has drawn a substantial part of its strength from the resources of the West. The great natural resources of the West have contributed to the needs of the Nation in both peace and war. The resources of the West were an important factor in the capital accumulation which made possible the development of the present-day American economy. Much of the use of the resources of the West was on an exploitive basis without much thought being given to the permanence of the economic foundation for the long-run. To a considerable extent, much of the West is still in transition from the exploitive type of economy to one based on resource use of a more permanent nature.

It is in the interest of the Nation as well as the West itself that the region does not become an economic liability to the Nation. Water is a key factor in the expansion of industry, the stabilization and intensification of agriculture, and the development of homes for the growing population. The large element of public interest in, and control of, the resources of the West serves to emphasize the importance of public water policy in the economic and social progress of the region.

In these times of stress at home and abroad it is vital that any weakness in the national fabric be avoided. The demands of a growing population at home and the burdens of world leadership suggest that the United States can ill afford to chance the possibility that any part of the economy make incomplete or wasteful use of natural resources. The time has passed when the United States can take comfort in the notion of inexhaustible resources. It is in the national interest to effectuate public resource policies which maximize the contributions all regions can make to the economic strength of the Nation.

Western Responsibilities to the Nation

The national interest in the development of the West is not a one-way street. The West has major responsibilities to the Nation in the develop-

ment of its land and water resources. The most important of these is to increase the level of state and local participation and action. Water resource development generally, and irrigation development in particular, are attractive subjects for promotional pressure by chambers of commerce and similar groups. Decisions are made in the political arena to the extent that many economists question the value of objective analyses of proposed water resource development projects. Too often it appears that economic analysis is ignored by Congress in authorizing new developments and that the choices are attuned to political pressures.

The West is not alone in possessing enthusiastic chambers of commerce or in the questions that may arise regarding the justification of certain public projects. Some of our questionable irrigation projects are no worse for example, than a Corp of Engineers improvement program for a particular East Coast harbor which was justified on the basis of a projected volume of traffic—traffic which could come only from another harbor fifty miles away, and which had been improved two years before with federal funds. This type of pressure for public expenditures on resource development projects adds up to the Congressional vote-trading procedure which goes under the name of "logrolling." It is a totaling of local pressures based on the idea that more population is good for every local community in the land. It fails to recognize that the basic objective of economic development should be to achieve a working balance between natural resources and population. To insure that water resource projects will be selected as the result of sound evaluation procedures, rather than on the basis of promotional ability, requires a greater sense of public responsibility in all parts of the Nation.

There are many aspects of water resource development which make necessary continued federal participation. Multiple-purpose projects include benefits which accrue to the general public and which are not limited by state or local boundaries. Many water resource projects are too large to be undertaken through private effort or by state and local units of government. Some water resource projects may have long-run benefits that only the federal government can afford to finance. On the other hand, there are many aspects of water resource development in which state and local units of government might well play a more important role in view of the fact that the benefits, both private and public, are primarily state and local in character. It seems likely that one of the best ways to discourage the promotional aspects of water resources development would be to increase the degree of state and local financial responsibility. This means more active participation on the part of state governments and the inclusion of other beneficiaries in repayment responsibility in addition to irrigation water users and hydroelectric power con-

sumers. It suggests more widespread consideration of the conservancy district as a means of assessing the taxpayer for public benefits of a local character.

The State of Montana has the best known and most effective state-sponsored agency for the development of new irrigated lands. Since it was established in 1934, the Montana Water Conservation Board has constructed facilities to provide irrigation water to almost 400,000 acres of land. This state agency has become a model for study by other states and the federal government. It has prompted proposals for a program of federal-state matching funds in order that such state programs might be encouraged and so that public benefits accruing across state lines might be financed by the federal government.

Western Water Policy in the National Interest

Public water policy should be considered, first of all, in its relation to a growing population and an expanding economy. Decisions with respect to public water policy should be based on objective study of the probable future demands for goods and services and the alternatives for meeting these demands. The domestic need for new irrigation development is dependent upon the demand for food and fibre which, in turn, depends on (1) the national population growth; (2) the western population growth; (3) the trend toward higher levels of nutrition; and (4) public policies with respect to food and feed reserves.

Additions to the Nation's supply of food and fibre may come from such sources as (1) the rehabilitation of eroded lands; (2) the alternatives in land reclamation; (3) regional adjustments in agriculture; and (4) the increasing application of technology to agricultural production. The potentialities of future technological developments in agriculture are the most difficult to predict but, also, may be the most important in meeting increased needs in the future.

Several lines of public policy are important in any consideration of public irrigation policy. They include: (1) the degree of emphasis on the traditional public policy of providing farming opportunities; (2) the degree of emphasis on irrigation as a stabilizer of other agricultural resources in the West; (3) the effect of public power development on industrial expansion in the West; (4) the extent to which public resource development may be used as a compensating device in the business cycle; (5) the relation of water resources to considerations of national security; and (6) the future trend of the United States' foreign trade policies.

Here, then, are fourteen factors which bear some relation to future irrigation development and public water policy. By way of summary, they include the four factors on the demand side of agricultural production,

the four factors on the supply side of agricultural production, and the six factors related to general considerations of public policy. Full consideration of all of these factors with proper weighting to each should produce a public water policy in the national interest. Obviously, this is one of those things that is easier to outline than to accomplish.

Of particular importance among the fourteen factors listed above is the one having to do with the industrial development of the West. Whether future industrialization is entirely a result of the decisions of private enterprisers, or is partially a result of public policies designed to secure decentralization of industry as a part of national security, the implications loom large for public water policy for the West. Industrial development with the attendant water requirements for hydroelectric power, domestic and industrial supplies, sewage disposal, and recreational purposes, complicates the problem of allocating scarce supplies. The problem may require more attention in the West than in other areas accustomed to think in terms of other water uses than single-purpose irrigation development. The questions of control of water and the institutional arrangements associated with control are likely to become increasingly important in the formulation of public water policy.

There are also important questions regarding the amount, kind, timing, and location of public investments which should receive careful consideration if public development of water resources is to be in the public interest. I submit that most public resource development which is authorized is not the result of objective study but has its source in political pressure, horse trading and expediency. When Franklin D. Roosevelt became President of the United States 20 years ago, he suggested the desirability of two federal budgets; one to cover the housekeeping functions of government and the other to include investment items. The idea was ridiculed as a subterfuge design to cover up an unbalanced budget. President Dwight D. Eisenhower had been in office about one month when news dispatches from Washington suggested that the new administration was considering a two budget system. President Eisenhower could also foresee trouble in making good on his campaign promises regarding a balanced budget.

I am a firm supporter of the idea that Congress should consider expenditures in terms of an operating budget and an investment budget. This support does not stem from any particular concern as to whether either political party is able to make good on campaign promises. Assuming a continuing program of public investment in resources development, I am convinced that our elected representatives in Congress should have to make some forthright decisions regarding investments the public should be making in its future. There should be an end to the burying of such investment items in the funds appropriated for the operating functions

of government. Only then are we likely to get policy decisions in the national interest. I am particularly interested in this question because, as I have pointed out, the public—the federal government—is a major factor in the development, control, and use of natural resources in the West.

Responsibilities of the Agricultural Economist

One other question merits consideration in the overall problem of water resources development. It has particular significance in view of the sectional viewpoint commonly adopted with respect to public water policy for the West. What are the responsibilities of the agricultural economist? I suggested ten years ago that the agricultural economist has two very definite responsibilities in connection with new irrigation developments.[4] First, he has a responsibility to bring to bear all research data and informed judgment available in order to increase the likelihood that only economically sound public developments will be undertaken. This means an evaluation process which considers both market and extra-market values. It means a totalling of benefits and costs with appropriate recognition of the public interest at the national, regional, state and local levels.

The second responsibility has to do with the place of the agricultural economist after the decision has been made regarding the water resource developments to be undertaken. In many cases, projects which can be shown to be uneconomical will still be approved and constructed because of the promotional pressures and political processes noted previously. The fact that an approved project may be questionable and that the individual economist may have been strongly opposed to its construction does not alter his responsibility to bring his efforts to bear to secure the maximum benefits from the development. In numerous instances, agricultural economists, as well as other agriculturalists, have continued to oppose and to obstruct orderly development long after there was any possibility of reversing the decisions leading to approval and construction. Although they may have considered the project uneconomical, once constructed it is a part of the resources of the area. The economist's concern is to maximize the productivity of those resources.

By way of conclusion, I would make this observation. There is no magic formula or model available at this time which can be used to determine public water policy for the West. The problem is huge and complex and much of it carries one beyond economics into questions of social goals, institutional reality and political forces. We are hopeful that more exacting economic analysis can be applied to the problem but we have a long way to go.

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[4] Roy E. Huffman, "War and Post-war Problems of Irrigation Planning in the Northern Plains," *The Journal of Land and Public Utility Economics*, vol. XIX, no. 4, November 1943, pp. 452-463.

ECONOMIC FACTORS IN WESTERN RANGE IMPROVEMENT

M. L. Upchurch
Bureau of Agricultural Economics, Berkeley, California

THE title of this paper implies that there is such a thing as "range," that it is subject to "improvement," and that economic factors somehow are involved in policy affecting such improvement. An examination of these economic factors and how they operate is the purpose of this paper.

Policy for use and improvement of the Western Range is a result of many things. Even a brief inquiry would take us far beyond the time and space allotted for this paper. So let us limit consideration to some of the economic factors that are pertinent to range improvement.

You need no proof that there is "range" or "rangeland." You have passed over a lot of it in attending this meeting. Some of you perhaps have thought of the range country as many miles of nothing; others are impressed with the wide expanses of spectacular scenery. But to all of you, the range country is a highly important resource producing a significant part of the meat we eat and the clothes we wear. Its use or abuse affects the water we drink, the irrigation of crops, and the attractiveness of vast areas for recreation.

Definitions

No wholly satisfactory definition for rangeland has been evolved and in some respects the term is ambiguous. The term "range" as used in the United States is unique; no other country uses a word that is exactly comparable. Clawson backs into a definition of range by saying, "Range livestock production is the production of domestic animals under conditions such that they receive a major part of their feed by grazing upon native or uncultivated plants. Range is the land upon which the animals graze."[1] This is as good a definition as any although it should not be examined too closely.

Roughly speaking, the range country of the United States consists of the 800 million acres lying between the eastern edge of the Great Plains and the Pacific. Close to 90 per cent of this vast area is used for livestock production and in acreage most of it is range or native grazing land. Great variation occurs in its soils, climate, vegetation, and other characteristics. Some rangeland is highly productive, comparing favorably with the intensively used pastures of the East and Midwest. Much of it produces relatively little forage per acre, while surprisingly little of it is completely

[1] Marion Clawson, *The Western Range Livestock Industry*, McGraw-Hill Book Company, Inc., New York, 1950, p. 1.

unproductive. A common characteristic of all rangeland is that the forage produced is harvested by grazing animals under relatively extensive management. Despite the lack of specific definition and the tremendous variations in characteristics, the term "rangelend" conjures the vision of the wide expanses of grazing land in the West.

"Range improvement" visualizes that something is done to rangeland to better its condition. Here the term is used to mean more intensive operation in the economic sense—that is, greater inputs of labor, capital, and management to obtain greater outputs of product per acre. Probably most rangeland is now operated at a level of inputs to outputs somewhat below economic optimum. Hence a program to increase inputs is consistent with economic efficiency, at least up to some undetermined point. This assumes, of course, that the inputs are appropriate and are performed without waste. Therefore the primary economic problem is to determine how much and what kind of additional inputs are justified by increased outputs.

Range improvements may take many forms and may apply to a wide variety of conditions. A range improvement may be simply better management of animals on rangeland, control of noxious plants by mechanical or chemical means, artificial seeding of native or exotic forage plants either with or without seedbed preparation, or construction of capital improvements such as fences, water facilities, corrals, or irrigation systems. Range improvements may be any or all of these things in various combinations and degrees. Common to all, however, is the notion that increased inputs of "know-how," work, and money will lead to greater output and to greater economic efficiency up to a point where marginal cost equals marginal return.

Unique Factors in Range Economics

Basically the economics of range improvement involve the same principles as the economics of any production process. The economic problem is one of equating marginal cost with marginal revenue within some time period for which decisions are made, at which point total output exceeds total input by the greater amount. Application of this basic economic principle to rangeland use or improvement encounters a host of unique complications growing out of the nature of the resource, the ownership of it, the interests in it, and the political and social institutions surrounding it. Let us examine some of these peculiarities.

1. One of the outstanding characteristics of the range country is the relatively low production per acre, along with wide fluctuation in production from year to year. Vast areas of the range country produce not more than an equivalent of one bale of hay an acre a year. Low production per

acre requires large tracts for economic units, which in turn requires sparse settlement and the private and social costs of distance and space.

Production not only is relatively low but may vary from almost nothing in some years to growth lush enough to mow hay in others depending on rainfall. As an example, rainfall at Susanville, California, a typical ranching area, has varied from a low year with 6 inches of moisture to a high with 32 inches. Variation in production makes it difficult for the rancher to keep the right number of animals to make full use but not over-use of the feed. Too few livestock wastes feed in good years; too many causes overuse in the bad ones. Public land agencies, especially the Forest Service, tend to permit only enough animals to use the feed properly in the scantier years. More might cause damage that could not be repaired in the good ones. The administrative job of fluctuating numbers according to the season has not been solved.[2]

2. Investment in a range improvement is a relatively high risk undertaking especially for some kinds of improvements and for some areas. Risks always are involved in making investments to increase output although some unusual risks are peculiar to rangeland. A Kentucky farmer may plant fescue and clover for a pasture and may be reasonably sure that fescue and clover will sprout and grow and a usable pasture will result within a reasonable and predictable time. A Nevada or New Mexico rancher may plant grass as a part of a range improvement program, but has considerably less assurance that anything at all will grow, or if it does, that the stand will be thick enough to use next year or several years hence. Drilling a well for livestock water is a costly and risky undertaking in many areas; the driller may not get any water or not enough at practical depths, or it may not be potable. Many range improvements may or may not produce the results intended. Risk is an economic factor to be reckoned with. It tends to increase the discount rate used to measure the returns to inputs.

3. Price uncertainty also is a factor in investment. Range improvement is unique in this respect in that a relatively long time usually is required between the investment and the return from it. Some range improvements may require a decade or more to pay out, if they pay out at all. Who can predict with certainty cattle prices far into the future? Shortening the time between the action and the end, reduces uncertainty so ranchers often favor improvements which promise quick returns even though long-run improvement programs may be more lucrative in the end.

4. Another peculiarity in the economics of range improvement lies in

[2] See Marion Clawson, *Economic Use and Administration of a Fluctuating Forage Supply*, USDA, BAE, Berkeley, Calif., June 1943, mimeo.

the difficulty of measuring input and output. Direct out-of-pocket expenses are readily identified but these are not the only inputs. Multiple uses and multiple entrepreneurship on much rangeland tends to hide some of the inputs because many different people are involved. Indirect or intangible inputs may escape precise quantification.

Similarly, output often is difficult to identify and measure. Direct output in the form of salable beef or lamb is readily determined, but much rangeland does not produce a directly salable form utility. Much of it, especially in areas of seasonal range, produces time utility, that is, it keeps animals alive from one productive season to another. Measurement of this time utility perhaps could be estimated by determining the cost of maintaining the animals for the time involved by the next best alternative means. In many places, however, no practical alternative exists. So far the worth of this time utility has not been worked out very well.

Range improvements may have far-reaching effects, one of which may be reduction of erosion. This may reduce sediment deposition in a reservoir many miles away, may extend the life of the reservoir, may reduce the cost of water to a distant city or increase the security of water supply for irrigation or domestic purposes. Here is only one of many examples, but it serves to illustrate the widely dispersed effects range improvements may have. Such effects have value even though it is difficult to measure. And further, such value may accrue to quite different people from those making the investment. Measuring total input and output of range improvement so as to determine the point of maximum profit over time becomes a highly complicated task.[3]

5. A further peculiarity of the economics of range improvement grows out of the relative immaturity of range technology. The technology of all agriculture is changing rapidly, but the techniques of range improvement seem to be especially fluid despite great progress in the science of range management. One can start an argument any time among range technicians by asking what and how improvements should be made on a particular piece of land. What forage plants should be seeded under given conditions? How should it be done? What machinery should be used? What is the expected physical response under given soil and climatic conditions? What kind of fertilizer should be used and to what effect? These and many similar questions cannot be answered very specifically by range technicians although rapid progress is being made in research in this field. Increased knowledge of physical and biological

[3] See Report of the Research Methods Workshop of the Economics of Range Resources Development Committee, Western AERC, Dec. 1-10, 1952, Logan, Utah.

relationships in managing and improving rangeland certainly will facilitate economic analysis of range improvement.

6. Land tenure, in all of its ramifications, perhaps does more to complicate the economics of range improvement than any other factor. Roughly half of all land in the range country is Government owned, either Federal or State.[4] About two-thirds of this land is used for grazing under permit or lease from the agencies administering it and this land supplies about a third of all the range forage requirements of the West. This excludes Indian land, which is a separate class of ownership more nearly like private ownership and used largely by Indians directly for farming and grazing. The history of this tenure situation lies beyond the scope of this paper. It is sufficient here to recognize that public ownership and administration of rangeland constitutes a significant part of the economic environment of the West.

Public land is used by private persons for grazing livestock under regulation by the administering agency. The private person, the rancher, nearly always owns real estate which he uses along with the public land. He hopes to make a profit from his total livestock operation, and not from just part of it. The administrator of the public land used for grazing is, in effect, a custodian of public property. As such, he hopes to attain the greatest public good from the resource in his custody. Economic decisions where public and private rangelands are involved are made by at least two persons and often by many more. Each decision maker is motivated by his particular situation and objectives. The rancher operates in a private competitive business realm in which he hopes to raise a family and perhaps pay off a mortgage. The land administrator operates in a public business realm in which he hopes to attain some measure of the "greatest good for the greatest number" or somehow to maximize net social product over time. These objectives of the joint entrepreneur of the range resource are not always in conflict, but conflicts do occur. Some grow out of honest differences in objectives and others grow out of incomplete knowledge and misunderstanding on the part of one or more of the parties concerned.

A further peculiarity of the tenure of rangeland deserves mention as it affects the economics of range improvement. Normally, ownership of land provides effective control. The owner of an Iowa farm can control access to it and determine who may harvest the crop from it. Effective control of much of the range country is decidedly less secure. Precise control of inputs and outputs by either private or public owners is not possible where intermingled ownerships occur which often are not coterminous with op-

[4] See R. D. Davidson, *Federal and State Rural Lands, 1950, with Special Reference to Grazing,* USDA Cir. No. 909, May 1952.

erating units, where land is of low productivity and fences are few, where management is extensive, and where common use of much of the land is unavoidable. Of course, much more control is possible now than in the days of the open range, although progress in this direction is relative.

An additional hazard of control lies in the fact that forage consuming game animals do not know, nor do they care, who owns the land upon which they graze. The Federal Government and private ranchers own most of the grazing land of the West and together they regulate the number, kind, and location of livestock grazed. But States, technically, own the game. Regulation of the number, kind, and location of game is a difficult task, often influenced and confused by many, varied, and conflicting interests. Nevertheless, the economic benefits a landowner may be able to reap from a range improvement depends on the game population. In one sample area in Northeastern California, for example, private land supplied two-fifths of the feed used by deer on winter range, and Federal land supplied most of the remainder, as well as most of the feed used by deer on summer range. The private land owned by forty ranchers in this area provided more than 12,000 animal unit months of feed for deer. At present any increase in range productivity in this area must be shared between livestock and deer on a first come first served basis.

7. The ranching business requires a lot of money. The proportion of capital to labor in it is relatively higher than that in most other kinds of farming. Further, a relatively large part of a rancher's capital is in land, even of those who operate partly on public land. Heavy fixed investment in land is a reality in the ranching business from which there is no escape. Even for operators using public land, grazing fees are at such a level that people are willing to pay substantial sums for the opportunity to acquire grazing privileges. About the only way a grazing permit can be acquired is to buy out someone who has one. The buyer must pay something like a full competitive price for the productive capacity of the ranch, including the part that is in public ownership. Operators who have bought their ranches feel that they have paid full value for their private land and for the productive worth of the public land, although their payment was not to the Government. To them, the "below full value" grazing fee is not regarded as a subsidy, but as a kind of "use tax" on something they have bought and paid for. In this way the grazing fee assumes an importance far beyond the annual price a rancher pays to the Government for the use of land. The relatively heavy investment already in rangeland may greatly affect the rancher's ability or willingness to invest still further in improvements. Many ranches are now capitalized at figures far higher than the rules of thumb indicate to be prudent.

Range Improvement on Private Land

Economic decisions relative to investments in range improvements on private land are somewhat less complicated than such decisions on public land, mainly because fewer people are directly concerned. To illustrate, assume the simplest possible situation—a rancher who operates entirely on private land (either owned or leased from another private owner), whose land is fenced so that control is reasonably effective, and whose operation is large enough to be reasonably efficient. Such a rancher makes economic decisions very much like those made by any other producer of economic goods. However, the realities of the environment within which he operates affect his decisions. If he considers reseeding a section of land, what kind of seed should he use? What is the best way to eliminate sagebrush? Will there be rains to sprout the seed and establish the stand? Will the stand be established well enough to use next year or three years hence? How much production can he expect from the seeded area, at what season, and how will this fit into the balance of the remainder of his ranch? Does he have the money to do the job, or can he borrow it, and on what terms? After seeding, can he protect it from rabbits, deer, or antelope? Even in this relatively simple situation, the unknowns in the economic equation loom rather large.

Now add some complications for the rancher who wants to improve his private range. Many people other than this landowner have an interest in what he does. If by seeding his section of land he can reduce the sediment deposited in a reservoir, the water users have an interest. If his action provides a little more winter feed for a herd of deer, the sportsmen have an interest. If his action provides a little more meat at a little less cost, the city housewives have an interest. These illustrations need not be multiplied to show that the public stake in improving and using to best advantage the private rangelands of the West is extremely important.

In the last twenty years the public has helped to pay the cost of a great deal of range improvement on private land through the Agricultural Conservation Programs and others. The rancher usually does some figuring on the returns to expect from the money he spends for improvements and local technicians make some judgment of a project where public money is used. Generally, however, no detailed cost-benefit calculations are made. Some economic analysis of the primary and secondary effects of range improvements has been made as a part of flood control surveys, but the "with and without" technique used leaves much to be desired.

The economics of range improvement is further affected by the size of operating units or firms in the same way as investments in other kinds of business. Contrary to common belief, many livestock ranches in the

West are rather small business enterprises. For the great number of small operators, investment in long-time improvements, while highly desirable to increase the size of business, presents real difficulties in financing. Financing improvements is much less of a problem for larger operators. For them the current rules regarding income taxes may greatly relieve the individual burden. For them too, greater size and flexibility of business may permit delayed income from pastures during the improvement period.

Ranchers who operate partly on private land and partly on public land must consider some additional factors in decisions on range improvement. They must consider how improvements on private land affect ranch feed and labor balance, including the public land portions. Ranchers attempt to balance marginal costs with marginal revenues throughout their entire operations. Where a public land grazing permit is a part of a ranch, the input-output balance may be somewhat different than where the operation is entirely on private land. Improvements that would increase feed supplies at a season already well supplied are not nearly as valuable as improvements that would increase feed in a season of short supply. These factors affect virtually every economic consideration of range improvement. The exact situation is different for every ranch, so that generalizations have little meaning. Each individual rancher must decide whether any particular range improvement will "pay" under his particular situation and at a particular time.

Range Improvement on Public Land

Economic decisions regarding range improvements on public land often are quite different, mainly because the concept of multiple use is applied to public land and public costs and social returns are of more concern. Public rangelands rarely are used only for the grazing of domestic livestock. Many forms of recreation (or at least the opportunity for them), varied wildlife, timber, and other economic goods and services are produced. More important than all these, perhaps, is the concept of the watershed. Most of the water available for use in the West comes from the high mountain country, much of which is used for grazing and most of which is in public ownership. The use of such country for grazing and the improvements made on it for range purposes may affect materially the quality and distribution of water run-off.

The economics of investment in range improvements on public land essentially is similar to the economics of investment in a multiple-product firm—again with some unique differences. If all the inputs were known and if all the products could be evaluated in comparable terms and if the supplementary, complementary, and competitive relationships be-

tween products were known, then the economic principles of enterprise combination could direct management decisions, including decisions on improvements. Unfortunately, however, the various products cannot be evaluated in comparable terms. Some products, such as livestock or lumber, have a market and a market price, but others have no market, although they have utility. They have value but not price. Many attempts have been made to quantify the utility of the "non-market" products of rangeland, but no widely applicable method is in sight.[5]

Enterprise combination, and hence the effects of improvements on the combinations, is further complicated by lack of sufficient knowledge of the relationships between enterprises. For example, what is the extent of competition between deer and livestock for feed? What effect does grazing by deer and livestock have on timber reproduction, water yield, or water quality? A growing body of research is reducing this area of unknowns, but investigators have much to learn. Once the competitive, supplementary, and complementary relationships between the products of range are known, the task still remains to evaluate them in such a way that economic comparisons of inputs and outputs may be made. If this too could be accomplished, theoretical models then can be used as tools to help determine the most advantageous combination of resources and products. Models, however, are of little use until good information is obtained from which to build them. The principle of equating marginal costs with marginal revenue so widely used in economic analysis is fine; but it is of limited use when neither the ingredients, the position, nor shape of the cost and revenue curves are known.

The major land managing agencies—the Forest Service, the Bureau of Land Management, and the Soil Conservation Service—as well as other agencies which manage public grazing land, all have made substantial range improvements and have plans for a great deal more. In total amount they are rather impressive. For example, between 1935 and June 1951 the Bureau of Land Management built 9,273 livestock watering places, 1,088 dams for soil and moisture conservation, and 10,214 miles of fence. Reseeding was done on 1,125,872 acres, brush and weed control on 951,819 acres, and pest control on 14,773,846 acres. More than 200,000 trees were planted, 521 corrals were built, nearly 800,000 feet of ditches and canals were constructed for water spreading, and 12,122 miles of truck trails were built.[6] These statistics seem large, but this work was spread over nearly 175 million acres. The investment per acre

[5] For an example, M. Saunderson, *The National Forest Officer Looks at Resource Values,* Jr. Forestry, April 1947.

[6] Report of the Director of the Bureau of Land Management 1951, U. S. Dept. of Interior, Washington, D.C., Tables 77A-B.

is pretty thin. The Forest Service has invested about $17,000,000 in range improvements covering some 140 million acres.

At present, the Bureau of Land Management, in addition to the grazing fee, collects 2 cents per animal unit month of grazing from the permittee as a range improvement fund. This money is supplemented by direct appropriations from Congress for improvements in general or for specific purposes such as toxic weed or insect control.

The Forest Service obtains funds for range improvements by direct appropriation. Section 12 of Public Law 478, 81st Congress, authorized the Congress to make annual appropriations for this purpose from grazing fee receipts at the rate of 2 cents per animal unit month for sheep and goats and 10 cents per animal unit month for other kinds of livestock under permit on the National Forests. Actual appropriations have been somewhat less than the amount so authorized.

Private Improvement of Public Land

Range improvements on the public land may be made under special permit by a rancher having a grazing allotment, or jointly by ranchers on common allotments, or cooperatively by them and the administering agency. Whether a rancher so invests his money depends not only on the input-output relationship of the project itself, but also on the tenure arrangement which may encourage or discourage him in making the investment.

Both the Forest Service and the Bureau of Land Management try to encourage permittees to make improvements on their allotments. Both grant special permits for improvements by permittees. Both may enter into cooperative agreements with permittees for improvement work. Nevertheless, the administration and the rules of the two agencies differ significantly.

The Forest Service, operating under the general principles of multiple use and of the greatest good for the greatest number, carefully guards against any action by any individual that would tend to establish or increase individual claim to forest land or its use. Hence, the Forest Service itself prefers to make necessary range improvements to the extent of available funds. As these resources are not adequate to meet the needs for investment, the individual permittee may be granted permission to make improvements under rather carefully defined circumstances. Until recently, all improvements made by the individual belonged to the Government. Now, Government title extends only to those improvements constructed partially or wholly by the Forest Service. Improvements for operating convenience, such as a cabin or corral, constructed by a permittee, belong to the permittee. He may remove them from the

forest if his grazing permit is discontinued. Special permits for improvements may be granted only if the forest supervisor is convinced that the cost can be amortized within a reasonable period.

The Bureau of Land Management also recognizes multiple use and social good, but operates under a somewhat different philosophy. Under the rules of the Bureau of Land Management the grazing privilege attaches specifically to the privately owned commensurate property. All improvements on the government range made by the permittee belong to the permittee. If the use of an allotment changes, the new user must pay the old user for unexhausted improvements and the Bureau sees that he does. The Bureau actively encourages development by the range user, either alone or in cooperation with the Government. This is done with the thought that: "(1) With a financial investment in the improvement project, the range user takes a more active interest and makes more careful use of the improvements; (2) financial participation by range users further assures the desirability of the project; and (3) with added funds the improvement program may be carried forth more rapidly.[7]

Perhaps the most important factor affecting the rancher's willingness to make range improvements on the public land he uses for grazing is the degree of assurance he has that he will enjoy the benefit of any increased production the improvement might cause. The printed regulations of the Forest Service and the Bureau of Land Management are similar on this point, but in actual operation, their effects are very different. This difference affects the confidence a rancher has in his relations with the agency and therefore his confidence in being able to reap the returns from an investment he might make on the agency's land.

Ranchers feel reasonably secure in their use of land under Bureau of Land Management jurisdiction. Privileges on Grazing Districts attach specifically to privately owned commensurate property. The Bureau does not recognize limits to the size of permits. The advisory board for each Grazing District has much to say on the distribution of permits. Improvements made by ranchers belong to them and the Bureau guarantees title. Ranchers have come to feel a high degree of confidence in the continuation of their grazing privileges and in their ability to increase livestock numbers, if improvements that are made add to the productive capacity of the land. Ranchers are making improvements on their Grazing District allotments.

The Forest Service, on the other hand, carefully guards the conditions under which a rancher is permitted to make any improvement lest he increase his claim for private privilege to public assets. Repeated re-

[7] J. Russell Penny and Marion Clawson, *Administration of Grazing Districts, Land Economics,* Feb. 1953, Vol. XXIX no. 1, p. 28.

ductions of permitted livestock on the National Forest to protect the resource have lessened ranchers' confidence in the future of their permits. The position of the Forest Service has been that less use will increase productivity of the range which, eventually will permit increased grazing. For the most part, this result has not yet been achieved. Many ranchers feel that reduced grazing for range improvement has resulted only in an increase in brush cover and big game numbers and that an increase in livestock production on the forests never will be possible. For many years the Forest Service policy provided for "redistribution cuts" in permits to increase the number of permittees. The idea of the greatest good for the greatest number often was thought to mean so little for so many that none could operate profitably. Although redistribution cuts are not made now, ranchers still remember them. These and other factors add to the rancher's reluctance to make investments to improve the productivity of his National Forest grazing allotment.

So the forest supervisor is in a dilemma. Grazing allotments on his forest may be in bad shape and perhaps deteriorating. He has limited public funds with which to make improvements to stop damage, much less to increase production. The main weapon available to the supervisor to reduce grazing damage is to reduce numbers and seasons of use still further. But often mere reduction of numbers fails to accomplish this end, especially on cattle ranges. The right answers do not come easily.

A recent statement by the Chief of the Forest Service declares that increased grazing capacity resulting from work done on the range by the permittee shall be available to the permittee. Increased production may mean more feed for the same number of animals or may permit increased numbers of livestock. Such an increase in use may be made ". . . provided the improvements: (1) are approved in advance . . . (2) do not conflict with other uses . . . (3) are beneficial to the range; and (4) continue to be effective."[8] The statement further provides that increases so obtained in permitted livestock will have preference status and limits will be waived in cases where permitted numbers go over the upper limit for the forest. Such a policy should do much to encourage ranchers to make improvements on their National Forest allotments.

One of the major sections of the so-called "Stockman's Grazing Bill"[9] provides that existing permittees be granted the privilege to use any increased production which may result from range improvements made by them. Such a statutory provision should do much to encourage ranchers to invest in their public land allotments. In effect, it also would guarantee

[8] Letter from Richard E. McArdle, Chief, Forest Service, to Regional Foresters and Directors, April 14, 1953.

[9] H R 4023, 83d Congress, 1st Session, Sec. 6(b).

to present users perpetual rights in grazing allotments except in cases of changes in land use.

Sometimes conflicts arise between individuals and the public agencies over what kind of improvements to make on the public range. These may grow out of differences of opinion or interpretation of the physical and biological facts involved or they may grow out of differing economic and social viewpoints of the parties concerned. The rancher wants to see improvements that "pay off" according to his notions of good business and within his "economic horizon" or time period for planning.[10] His notion of a profitable investment may be influenced greatly by the risks, uncertainties, and institutional environment applicable to the situation. The public land administrator may have a quite different economic horizon and view of the risks and uncertainties. To the public land administrator, answers to questions of range management are found in the condition of the land. To the rancher, answers are found in the condition of his bank account. Conflicts of this sort perhaps are inevitable where decision making rests with two parties each of which operates within a different environment.

Conclusion

One of the main problems for economists who concern themselves with the range livestock industry is to learn how to apply the principles of production economics to the peculiarities of the business. The problems, however, are probably no more difficult than those encountered in the economics of dairy marketing or the economics of foreign trade, to cite just two examples. The area of unknowns seems rather large now because relatively little work has been done in this field by economists. A program of research in the economics of range improvement is being undertaken now. A regional cooperative study under the Research and Marketing Act was activated recently with six States, the Territory of Hawaii, and the Bureau of Agricultural Economics participating. This broad attack on some of the economic problems of rangeland use should produce information useful for individual management as well as for public policy decisions in the future.

Individuals have disagreed with their government over the use of public property since the colonists flouted the King's broad arrow and cut the spar trees in the New England woods two centuries ago. Public policy for the Western Range has produced a rash of controversy for

[10] John A. Hopkin, *A Theoretical Framework for Economic Analysis of Western Range Lands,* unpublished manuscript presented at Research Methods Workshop, Economics of Range Resource Development, Western Agricultural Economics Research Council, Logan, Utah, Dec. 1952.

nearly 100 years. Despite continuing study, major questions may remain unanswered for a long time because ideological as well as economic goals differ among people and breed dissimilar answers to the same questions. Individual and social goals continue to be far apart in many instances.

We are much closer to harmonious solutions to some of the public policy issues now than ever before despite the storm of controversy stirred up by the "Stockman's Grazing Bill" in this last Congress. But major economic questions still are unanswered and they require our most talented thought and careful research. One of these is, how much can the rancher and the public afford to invest in range improvements? The range management technicians and the economists must work and are working together to show the way to usable answers.

Despite the difficulties of applying traditional types of analysis to the economic problems of the range livestock business and of rangeland use and improvement, much progress is being made toward better understanding of the principles and factors involved. Continued search for pragmatic and workable answers to specific practical questions eventually will lead to clearer insight upon which private decisions as well as public policy may be based.

DISCUSSION

KARL S. LANDSTROM
Bureau of Land Management

I find myself in general agreement with Dr. Upchurch's paper, which so comprehensively outlines the economic factors involved in rebuilding the Western range. My remarks will consist primarily of re-emphasis, largely from the standpoint of the public lands, with some minor points of difference.

The term "range rebuilding" rather than "range improvement" better describes the general subject matter we are discussing. "Range improvement" has taken on a rather restricted meaning, associated with structural improvements such as wells or fences placed upon the land, as under the Bureau of the Budget category bearing that title. The term "range rebuilding" conveys more adequately to me the magnitude of the job ahead, as well as the almost spectacular change in condition and productivity that can be obtained on deteriorated range under some circumstances.

We generally assume that a landlord has at least a partial responsibility with the tenant to see that added inputs are made to land where such a program is warranted by the added outputs that can be obtained. The government, in the case of the unreserved public domain, did not assume its obligation as a landlord until 1934. Under the Taylor Grazing Act, a system of management and control was introduced and is still in the process of adjustment. Considerable progress has been made in arresting the deterioration of the range, but the program has not been adequate to keep abreast of continuing deterioration. The need now is for a comprehensive program to rebuild the Federal range to the level justified by its resource potential.

This program in general consists of four phases: adequate range management; protection from fire; range revegetation; and soil and water conservation.

The outstanding factor mentioned by Upchurch is that most range land probably is being operated at a level of inputs below economic optimum. This situation seems to have come about in part because action in applying technology to the land has not kept pace with improved technology. Upchurch is right in stressing the unusual risks and uncertainties that beset those who would rebuild the range. However the risks are by no means uniformly severe. Advancing technology is reducing the risks. Even artificial reseeding has advanced from the experimental stage and is now an accepted practice where the land and climate are adapted to it.

An outstanding example of progress is a reseeding known as the Highway Unit, located abreast of U. S. Highway 30 a few miles east of Rupert, Idaho. Some of those attending this meeting may have observed the sharp difference between this reseeded land and nearby untreated sagebrush. There are similar examples in other states. The success to date suggests that the time has come for an accelerated program.

Upchurch has explained in some detail the tenure situation surrounding the grazing of public lands, and the opportunity for ranchers to rebuild National forests or Federal range at their own expense. Both the Forest Service and the Bureau of Land Management encourage the participation of stockmen in range improvements, recognizing that appropriations for such work have been inadequate to do the whole job.

The policy of the Bureau of Land Management is to encourage participation by stockmen in the construction and maintenance of range improvements on public lands, both within and outside of grazing districts. Edward Woozley, Director of the Bureau, has expressed a belief in more participation by local groups and in building up the carrying capacity of the range rather than by reducing grazing, wherever such is possible. The announced intention of the present Administration to reduce Federal expenditures wherever possible indicates that even more of the development than before must be financed by private capital. An immediate objective therefore is to make it more feasible and profitable for private capital to do the work.

I am glad to know that Dr. Upchurch's research has revealed that ranchers feel reasonably secure in their use of lands under BLM administration. Perhaps, however, the guarantee of title to range improvements constructed by ranchers is not quite so iron clad as is implied.

The vacant, unreserved, unappropriated public lands, which include most of the Federal range inside grazing districts, is still subject to disposal as by homesteads, selections, desert entries, or exchange, providing the lands are classified as suitable for such disposal. Disposals under some of these forms are running rather high. In Idaho, for example, current applications for desert land entries aggregate some 250,000 acres, and this land is generally of a type that would be well suited to reseeding. Efforts are being made to channel the reseeding program into areas that are not adapted to desert entry to avoid loss of investment in reseeding. Periodic requirements also exist for the withdrawal or transfer of BLM lands to other agencies for administration. Usually this involves discontinuation of grazing or at least a loss of grazing preference to the former user. Both of these activities—disposals and withdrawals—tend to create some uncertainty as to the future availability of specific tracts of public lands for grazing and may be a deterrent to investment by private capital.

One difference between the Forest Service and the Bureau of Land Management in this respect is that the Forest Service has the authority to buy structural improvements in place on National forest lands at the appraised value when the grazing use of an area is discontinued, although it is not obligated to do so. This provides a means of compensating a rancher for an investment he has made in range improvements. The Bureau of Land Management has no provision by which appropriated funds may be used to compensate a rancher for range improvements. However, it is the policy to require those who apply for public lands to agree to compensate permittees or lessees for investments that they have made when continued use will be denied them. Where public lands are withdrawn for national defense purposes, the Department of Defense has been authorized by statute to compensate range users for the loss of their improvements and grazing privileges. However no provision has been made for compensation in the case of other forms of withdrawal.

A major obstacle to more rapid rebuilding of the Federal range by private capital is the slowness with which the range is being divided into individual grazing units or allotments. Prerequisite to such division is complete adjudication of the grazing privileges existing thereon to the qualified stockmen. This in turn demands that adequate inventory surveys of the public range and the base properties be available. The lack of adequate up-to-date range and dependent property surveys is seriously retarding the application of desirable range management practices, including the planning and installation of range improvements. The rate of inventory surveys is a matter of size of appropriations.

Upchurch mentioned the program of Federal subsidy for range improvements on private lands under the Agricultural Conservation Program. This program has been running at an annual rate of four to five million dollars in payments to ranchers, plus the costs of technical assistance and administrative overhead. The total appropriations for range improvements, soil and moisture conservation, and noxious weed control on the Federal range under BLM administration has been running about four to five million dollars a year including administrative costs.

Upchurch's discussion of the role of the so-called "land administrator" infers perhaps that these individuals have more freedom of action with respect to the public range than actually exists. I think it must be remembered that the Congress holds within itself a high degree of control over the nature and rate of range development work on both private and public lands through its exercise of the power to appropriate public funds.

In conclusion, I would like to express my appreciation for several opportunities I have had in recent years to work with Dr. Upchurch and persons associated with him in the program of research in the economics of range land development which is now under way in six states and Hawaii. This program, I trust, will provide answers to many of the unknowns and will speed the day when more rapid progress can be made toward rebuilding the Western range.

LONG RANGE PROSPECTS FOR AGRICULTURE

Chairman: Howard Mason, University of Nevada

LONG RANGE PRODUCTION PROSPECTS AND PROBLEMS

CARL P. HEISIG*
Bureau of Agricultural Economics

THE program-makers have suggested that "long-range" include a period running from 1955 to 1975. This might have been interpreted to mean an analysis or forecast of the nature and sequence of events over a continuous 20-year period. In this paper I shall take a different approach. My discussion will deal with prospects and problems in the latter part of the 20-year period and separately with those of the earlier part of the period.

I find it impossible to think through long-range production prospects without giving some consideration to demand. Although on this program separate discussions of the production and demand aspects are assigned, I shall make certain comments or assumptions in regard to demand when it seems necessary. But I hope that this will not infringe unduly on the prerogatives of the speakers who follow.

A further introductory comment. I assume from comments of the program chairman that the major purpose of the speakers is to provide the framework and stimulation for the general discussion to follow. With this in mind, I propose to summarize briefly certain of the major conclusions found in several recent studies of this problem. Realizing that this may be somewhat repetitious of discussions of these studies in one or two previous meetings of the association, there still is need to refresh our memories a bit for more effective discussion.

Production Prospects by About 1975

In appraising the long-range prospects for agricultural production in this country, I shall center first on a point in time 20 or 25 years from now, or about 1975. Most of the recent projections of production have used this reference point.

One such appraisal was the Report of the President's Water Resources Policy Commission.[1] The technique used in that analysis was to express both requirements for farm products and production potentials in terms of "cropland equivalents." On this basis, requirements for cropland in

* The author is indebted to Glen T. Barton and H. L. Stewart of the Bureau of Agricultural Economics for assistance given in the preparation of this paper.

[1] *A Water Policy for the American People.* Report of the President's Water Resources Policy Commission. Washington, D.C., December, 1950.

1975 would total about 100 million acres more than in 1945-49. The report concludes that "This comparison shows that full development of the production potentials will barely provide sufficient production to meet the requirements anticipated by 1975." The conservative nature of this conclusion regarding long-range production prospects is further emphasized by the fact that no change was assumed in per capita consumption between now and then.

Another analysis projects an increase in requirements for farm products of 38 to 40 percent between 1950 and 1975, based largely on a population projection of 193 million and a substantial increase in per capita consumption of farm products.[2] The quotation that follows briefly summarizes the conclusions reached in that report regarding long-range production prospects:

"Taking into account the increases in production likely to come from raising the productivity of present crop and range lands, we estimate that agricultural requirements can be met by 1975 without adding in any significant way to the total of 1.1 billion acres of land now in farms. This can be done by improving or upgrading the use of much of the land now in farms, and by bringing in new land only to offset any farm acres that will be taken out for urban and other uses." This conclusion is much more optimistic than that reached in the report of the President's Water Resources Policy Commission.

The summary conclusions of a third recent report, which was prepared by the United States Department of Agriculture, with respect to long-range production prospects are as follows:[3]

"The projected output index . . . would be about 35 percent above the 1947-49 average. Such an increase would supply the projected domestic and foreign demand for United States farm products. . . . Thus, it seems reasonable to conclude that during the next quarter century farm production in the United States can be substantially increased. This assumes that economic incentives to farmers to adopt improved production practices will exist. But economic incentive alone will not insure that the needs for food and fiber will be met . . . intensive research and educational efforts will be needed. Special efforts also will need to be devoted to maintenance of soil resources so that higher crop yields can be sustained." This conclusion of the USDA report represents a middle ground between the relative optimism of the report of the Materials Policy Commission and the relative pessimism of the analysis of the Water Resources Policy Commission.

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[2] Report of President's Materials Policy Commission, Washington, D.C., June, 1952.

[3] *Agricultural Programs of the United States—Current and Prospective.* A report to the Food and Agriculture Organization, U. S. Department of Agriculture, Washington, D.C., November, 1952.

What do we conclude from all this? And what interpretations have been made by various groups as to the meaning of these studies? As frequently happens when courses of action or promotion of causes must be based on an uncertain future, with guide lines tenuous at best, different people draw different conclusions from essentially the same set of relevant data, and they frequently draw their conclusions from a limited portion of the subject.

The Neo-Malthusian is convinced that we face a squeeze on food supplies in the near future even in this country. The land-development enthusiast is closely allied to this viewpoint and sees it as justification for great expansion in irrigation and other reclamation developments. The ardent conservationist places the emphasis somewhat differently, but again he tends to be pessimistic about increasing supplies of food fast enough. Ordinarily, however, he takes a rather long view. The research administrator becomes somewhat alarmed over projections that imply continued easy advance in increasing farm output for fear that temporary surpluses may obscure the evident need for research. Still others interpret the projections to mean that problems of agricultural income and price will tend to become less important over an extended period but that they will be severe during all or most of the next decade or so. There are elements of truth in most of these viewpoints. My own view is that we can dismiss without too much concern the question of whether enough can be produced to meet foreseeable demands during at least the next generation. The big questions are "At what cost?" and "What adjustments are involved?"

Each of the three analyses I have reviewed concluded, with varying reservations, that it should be possible to produce enough farm products to meet the demands anticipated by about 1975. Future possibilities for elimination of waste in storage, transportation, and handling of farm products adds further assurance that these needs can be met. Further substitution of nonfarm for farm products is another likely means of relieving future pressures on our farm-production resources.

I do not say that these increases in production will come easily. Difficulties will be encountered. All of the analyses stress the future importance of higher yields of crops and livestock. Conservation of soil resources and an adequate supply of technology are prerequisites to increasing or even maintaining our present yields. Dr. Byron Shaw has sounded a warning note regarding our supply of technology. After careful appraisal he has concluded that we are not turning out new research findings at a rate equal to the rate at which those available are used.[4]

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[4] Byron T. Shaw, *The Role of Research in Meeting Future Agricultural Requirements*, a paper presented at the Annual Meeting of the American Society of Agronomy, Cincinnati, Ohio, November 18, 1952.

In order to meet these future demands for agricultural products physical research on agricultural production must play an increasingly important role. There will be greater need for economic analyses of alternative adjustment possibilities and of cost-reduction opportunities, both from a national and an individual-farm viewpoint. Expanded educational activities will be needed to bring the results of research more quickly into use by more farmers.

Prospects for Improvements in Efficiency

Let's turn now to a brief discussion of what I consider the more pertinent economic question—our ability to increase the efficiency of farm production over the long run.

The past record on efficiency in farm production has been good. Output per man-hour of farm labor is now two and a third times that of 40 years ago, and nearly 75 percent higher than it was 15 years ago. This substantial increase in productivity of farm labor has keynoted our rapid advances in farm technology. Progress in farm mechanization has been the chief factor responsible for the rise in labor productivity, but increases of yields of crops by a third and of livestock production per breeding unit by 20 percent during the last decade and a half have contributed substantially.

These increases in production per man-hour, per acre, and per breeding unit represent greater efficiency in the use of three production inputs—farm labor, cropland, and animals. Less farm labor and cropland and fewer breeding units of livestock are required per unit of farm output today compared with a generation ago. But, increased quantities of machinery, fertilizer, and other production inputs were used to achieve these results. Consequently, no valid conclusions can be drawn solely from the data on production per man-hour, per acre, and per animal regarding changes in the overall efficiency of farm production.

To get at this problem more directly, we have constructed an index of combined inputs used in farm production which provides a measure of change in overall efficiency when the index of combined inputs is related to the index of farm output. On this basis, we now get about 25 percent more farm production per unit of combined inputs than we got about the time of World War I; or stated another way, a unit of farm output is now produced with about 20 percent fewer inputs than were required a third of a century ago. During this period farm output rose by about two-thirds, while total inputs increased by nearly one-third.

The long-time changes in efficiency of production are closely related to the processes by which farm output has been increased. At least two broad aspects of this past relationship have important future implications:

1. *Input-saving innovations (in terms of input per unit of output) have*

been largely output-increasing. This has particular significance in periods when supply presses on demand. Replacement of animal by mechanical power and improved practices leading to greater crop and livestock yields are notable examples.

2. *Nonfarm production resources have been increasingly substituted for farm labor and farm land.* Commercial fertilizer, farm machinery, and petroleum products are among the more important of these resources.

In the appraisal of long-term prospects for production, it was concluded that increases in yields of crops and livestock will form the chief basis for future expansion of farm production. This would assure further increases in efficiency of use of cropland and livestock. On the basis of past experience it would mean also that farm labor would be used more efficiently. These conclusions are supported by the results of the recent study of agricultural productive capacity made by the Land-Grant Colleges and the U. S. Department of Agriculture. This study concluded that, under conditions of high-level demand, farm output could be increased by about 20 percent within 5 years without any significant change in amount of farm labor or farm land.[5]

The longer-term prospects for increases in overall efficiency of farm production are not too clear. Although continued substitution of nonfarm production resources for farm land and farm labor would result in greater efficiency in use of land and labor, it does not necessarily follow that total inputs per unit of output would be reduced.

More intensive use of fertilizer, machinery, and other inputs would be a means of increasing production, but eventually we would reach a point at which output would increase less rapidly than inputs. Although the evidence is not conclusive, available data indicate that during the last few years total inputs have increased at about the same rate as total output. Whether this is mainly because of inventory accumulation of such things as farm machinery and refurbishing of the farm plant is not clear.

Further increases in scale of operations—larger farms, herds, and flocks—should add to production efficiency in the future as in the past. Greater mechanization, especially in the South, will also contribute to advances in overall efficiency. But the probable changed composition of our future farm output will add to the difficulties of increasing overall production efficiency. Greater relative emphasis on livestock and livestock products would call for increases in efficiency on enterprises which in the past have generally lagged behind on this score.

The greatest assurance for a continuation into the future of our long-time increase in overall production efficiency is a continuing supply of

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[5] *Agriculture's Capacity to Produce,* Agriculture Information Bul. No. 88, USDA, Bur. Agr. Econ., June, 1952.

new innovations in production techniques. Increased emphasis on both physical research and economic analysis of production alternatives are basic, not only to the assurance of an adequate future supply of farm products, but also to the attainment of this goal with increased efficiency. The need for greater efficiency in use of resources in the longer-run future may well be the more important justification for increased emphasis on research.

In summary then, the longer-range prospects suggest that our problems of matching supply and demand and our related pricing and adjustment problems would not be too difficult of solution. But before we get to this easier life we must live through an intervening period. It is not difficult to see problems during the next 5 to 10 years that will differ considerably from those of the longer-run period.

Prospects and Problems During Transition Period

In these days of declining exports, marketing quota referenda, and discussions of farm programs and price supports, all of us are aware of the fact that demand will not tend to outrun production in all of the next 25 years. In contrast with the longer-time period, in which an increase in both volume and efficiency of production must be emphasized, surpluses of several agricultural commodities already confront us. These problems may become even more acute.

Of course, if we should be faced with a drought similar to those of the 1930's, or if the international situation should worsen considerably, a different set of conditions and problems would confront us. The discussion that follows assumes that we will be fortunate enough during the next decade to live under more or less normal conditions, with respect to both war and weather.

Our farm plant is geared to high-level production as a result of the unprecedented demand of the last decade or so. But today, even though our domestic demand generally remains high, a decline in effective export demand promises trouble for a number of commodities. Just a year ago, in the 1951-52 marketing year, exports provided the market for two-fifths of the wheat we produce, between a third and two-fifths of our cotton, half of our rice, a third of our grain sorghums, a fourth of our tobacco and lard, and substantial portions of a number of other commodities. Despite the large increase in domestic demand, exports have recently provided the market for more than 50 million acres of cropland compared with about 20 million acres from 1937 to 1941. Despite the concerted efforts made to maintain our export markets and to develop new ones, it appears reasonable to expect that with continued economic recovery throughout much of the world export markets for some commodities will decline

substantially from the record levels of recent years unless special arrangements are worked out.

The first major problem in our transition period, then, is that of developing effective markets. This is the subject of the other two papers and I shall not belabor it here except to point out its cardinal importance to our nearby production prospects and problems.

An additional problem that confronts us is that of deciding upon and achieving the most effective use of the millions of acres of cropland which may have to be diverted to uses other than production of "surplus" commodities without undue sacrifices in farm incomes or undue cost to the Federal Government. The longer-range prospect for relatively greater demand for livestock and livestock products provides a clue. If adjustments are made in the near future that will bring about economic balance in our production pattern, then within a relatively few years our increasing population should relieve the pressure of supplies on demand. But in the meantime the problem will be to find uses for this "diverted" acreage that will be both soil-conserving and profitable. In this period of declining farm prices and still high costs, farmers will generally adopt the most immediately profitable alternative uses for diverted acreages. If the soil-conserving uses that are needed for the longer pull do not appear to be profitable, they will find little favor with farmers in a period of declining incomes.

The extent of our adjustment problem will depend upon the success of our efforts to maintain our old markets and to develop new ones, both at home and abroad. It will also depend upon the extent to which farmers retain old, and adopt new, yield-increasing practices. In turn, our ability to maintain markets in a period of increasing competition will depend to a considerable extent upon our ability to increase our efficiency of production (and marketing) and thereby to increase our competitive position in the market place. In such a situation it is obvious that farmers, educators, legislators, and program formulators will need all of the guidance in research that can be mustered in appraising the nature of market changes to be expected, the types of production adjustments best suited in different farming situations to ease the impacts of changing markets, and the production and marketing efficiencies that can be achieved to lower costs and to maintain equitable farm incomes.

Substitution of nonfarm production goods for farm labor and farm land in the past has meant that cash costs of production have increased greatly in importance. Farmers thus have become increasingly vulnerable to price-cost squeezes. This may be especially important in the next 5 to 10 years and it represents a periodic threat over the long run.

Cost reduction in the transition period would seem to offer a means

of bolstering net farm income. The difficulty on this score is that historically innovations and techniques which reduced inputs per unit also generally increased total output. Continuation of this historical relationship under conditions of stable or declining demand would mean that gains to farmers from reductions in cost would be largely dissipated by the adverse effect of increased output on prices of farm products.

In the absence of an expanding market, then, a real need exists for adjustments and techniques that reduce costs without increasing output. Examples of such opportunities, from the standpoint of an individual farm or of a farming region, are not too difficult to find. The difficulty arises when we consider the output of agriculture as a whole. For instance, dairymen in the Northeast might increase the production and quality of pasture and roughage to substitute for purchased concentrate feeds and thus lower their cash expenditures. But this would reduce the market for feed grains from the Midwest and would result in greater total output for the country. But the search for innovations that reduce costs without increasing output should have high priority for both physical scientists and agricultural economists in the next few years.

The exact nature and extent of the production adjustments that will be required in the next few years are still largely matters of conjecture. But there are already surpluses of some major commodities and a brief examination of a few of these should suggest the nature of the problems.

Wheat probably has drawn more attention in the public press in recent months than any other commodity. We had still about 580 million bushels of wheat in our bins when we began this year's harvest. A year from now we will probably have more than 700 million bushels. A national acreage allotment of 62 million acres, for the 1954 crop calls for a reduction in plantings of 16½ million acres, or about 21 percent.

Most of the reduction in acreage of wheat will have to be made in the Great Plains and Pacific Northwest where about four-fifths of our wheat is seeded. Our problem there is magnified by the fact that in many of these areas profitable alternatives are limited. Preliminary analyses, however, suggest that feasible alternatives to wheat are more prevalent in the Great Plains wheat areas than is generally believed. In most of the fallow areas, for example, many farmers could fallow a larger proportion of their cropland and thus reduce operating costs somewhat. In the grain-sorghum areas many farmers could shift part of their wheat land to grain sorghum without sacrificing income. In the eastern portions of the Plains feed crops and livestock are as profitable as wheat on many farms. Grass and livestock represent a feasible alternative to wheat on some of the larger farms, at least throughout much of the Plains area where stock water, fences, and buildings are available; but heavy investments and

a postponement of income would be required by such an adjustment.

But even so, we must conclude that on many farms in our major wheat areas a reduction in wheat acreage means a reduction both in incomes and in efficiency. A further complicating factor is that a shift from wheat to grain sorghums in the southern Plains or from wheat to feed crops in the eastern Plains, although it might not reduce farm incomes significantly there, would help to aggravate any surpluses of feed grains that might develop to plague other agricultural regions.

Butterfat and other dairy products represent another possible major surplus problem in which we need to examine not only our production techniques and alternatives, but also our marketing and regulatory activities and our pricing policies. We need to learn the relative prices at which butter can compete effectively with margarine, and at which consumption of fluid milk can be expanded. We need to examine our sanitation and other regulatory activities to decide whether we can eliminate some needless production and marketing costs. On the production side, we need to appraise more thoroughly the opportunities for increasing efficiency and reducing costs. Recent analyses in the Great Lakes and Northeastern dairy areas suggest that some dairy farmers can reduce their production costs by as much as 25 percent by adopting various improved practices. But many farmers are not in position to make such adjustments because of limited resources or managerial ability, or because of the nature of their operations. The problem is particularly acute for butterfat producers in the western Corn Belt and eastern Plains. We should be finding now the more feasible alternatives for such farmers.

During the next few years *cotton* can expect increasing competition from both foreign supplies and domestic synthetics. By increasing our efficiency of production and decreasing our costs of production we could probably hold a substantial part of our cotton market, but some reduction in acreage of cotton would doubtless still be required and the recent shift of cotton production from some of the older, less-favored cotton areas of the Southeast to more efficient areas would need to be continued. In the Southeast alternatives to cotton that will maintain farm incomes and productivity of the soil will be especially important. Improved pastures and livestock have been such an alternative during recent years with favorable livestock prices, but they should be re-appraised in light of the price-cost relationships that are likely to prevail in the next few years, and compared with other alternatives.

In deciding upon feasible alternatives for cotton and for other "surplus" commodities, we must appraise the interregional competitive aspects of the proposed adjustments. If, for example, increased production of dairy products and beef in the South were to mean primarily an expansion in

local consumption, such adjustments would be more pertinent than if they meant a contraction of markets for producers in other regions. There has been a tendency to neglect such considerations in recent years because of abnormal demands. But in a period of surpluses they become increasingly important.

It is obvious that we have not found a ready means of coping with problems of surpluses. How then can economic research contribute to the solution of these transition problems of adjustments in production? It seems to me that a real need exists for a broad-scale economic research program that would point out desirable transition adjustments and ways in which they might be facilitated and made profitable to farmers. I realize that attainment of economic balance in agriculture is a continuing problem because of variations in market demands, changing technology, and other factors; but it is likely to be especially difficult during the next decade.

Such research should be conducted in all significant local type-of-farming areas, but with some integration of efforts, so that the aggregative effects by regions and nationally can be approximated. What may be a profitable adjustment for an individual operator or a small group of farmers may have quite opposite effects if adopted generally. We need to know whether adjustments that appear to be desirable for farmers as a group, as well as in the public interest, can at the same time be made the most profitable alternative for individual farmers. If group and individual interests can be reconciled, a powerful incentive will be given to achievement of economic balance.

A broad-scale appraisal of adjustment opportunities and problems of this type would point out the changes in farming that probably would be most profitable in view of market prospects, technological improvements, and other forces. Local and area reports would furnish a useful foundation for local extension and other activities concerned with farm management and balanced farming programs. Area, State, and national reports would provide guidance to public agencies concerning ways of achieving profitable, efficient, and sustained production. Such studies should not be considered a one-time undertaking, but rather an extension of an economic research program designed to provide continuing research appraisals of farming adjustments to changing economic and production conditions.

LONG RANGE DOMESTIC DEMAND PROSPECTS FOR FOOD AND FIBER

HARLOW W. HALVORSON
University of Wisconsin

BEFORE coming to grips with the main issues involved in appraising the prospective long range demand for food and fiber, I would like to make a few remarks dealing with the setting of the problem. Long range prospects for any facet of our economy of course must be appraised in the setting in prospect for the whole. What is implied, therefore, is knowledge of the economics of growth as it applies to the economy as a whole as well as to that part with which we are concerned. But, as one writer has so ably shown, "the theory of growth is an underdeveloped area in economics". In the absence of adequate foundation, perhaps one is forced to proceed on faith as did the President's Materials Policy Commission when, in affirming its belief in the principle of growth, it argued "granting that we cannot find any absolute reason for this belief we admit that to our Western minds it seems preferable to any opposite, which to us implies stagnation and decay". While faith in the future may certainly be relevant to the course of developments let us hope that as economists we shall soon have a firmer basis for analysis.

Long Range Prospects for the Economy Generally

Most of us would have considerable difficulty in picturing the size and functioning of our economy in the aggregate say 25 years hence. As a matter of fact the economy is something more than the sum of its parts even if these parts were completely known. Furthermore, there is serial interdependence among them so that the variables and relationships in the future may depend upon the magnitudes of variables in the past and continuing present. None of the important variables are completely exogenous in the long run. In addition, statistical measures do not reveal the effects of many aspects of growth, particularly influences of institutional change and some technological aspects of progress. But even where measurements are available for projection, the cumulative impact of slight variations in average growth rates in any of a great number of variables can alter substantially the conclusions which can be drawn from these projections. With these recognized limitations it is here assumed that the structural changes in our economy in the next quarter century will be rather insignificant and that for our purposes examination of a limited number of strategic variables will provide the framework for insight into future developments. This is inadequate, but we have yet no basis for prediction of structural change.

The measures of real national product are the simplest statistical summary statements of the magnitude of our economy or economic activity. Perhaps Gross National Product at constant prices is about as good a measure as any for this purpose. During the past few years several important studies have been published involving projection of our economy to some future date and, therefore, either explicitly or implicitly incorporating projections of the components.[1] Most of these seem to have assumed the continuation of past relationships and time trends (often linear) adjusted by more or less well informed hunches and further conditioned by varying degrees of faith in the future. The recent President's Materials Policy Commission report may be cited as an illustration of this. A continuation of the past 3% rate of growth of GNP in constant dollars was assumed for the next 25 years thus implying a doubling in GNP between 1950 and 1975. An increase in productivity per man-hour of 2.5% as against the historical 2.1% was assumed "because it seems reasonable to expect considerably steadier levels of employment and economic activity in the future, in line with the avowed national objective of making major depressions a relic of the past."

On the matter of growth in our national product, there seems little question but that, barring atomic warfare, the next generation will see an increase in this product. However, the rate of such increase is a highly debatable matter. Starting from a somewhat different basis than the PMPC, but merely fitting trends to GNP per person employed (adjusted to a 40 hour week), the period 1929-51 (eliminating 1944 and 1945) yields an annual rate of increase of 2.3%. However, the period 1938-51 (again excluding 1944-45) indicates a rate of only 1.6%. Use of each of these growth rates when projected for a quarter of a century yields greatly different results. Using the lower of these rates one arrives at a 1975 projection of GNP in 1939 dollars of $243.5 billion as compared with $308.6 billion by the Commission or a difference of some 21%. Neither one of these should be taken as a forecast as such, for an intelligent forecast would have to incorporate more than mere extrapolation of average trend values. It would seem, however, that for projection purposes the rate of increase in productivity per unit time of labor input based on the last half century may overstate the prospective rate of increase for several reasons:

(a) The first half of the 20th century probably represents a period in which we were still 'skimming off the cream' of our natural resources.

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[1] J. Frederic Dewhurst and Associates, *America's Needs and Resources* (New York, 1947).

Robert W. Hartley, *America's Capital Requirements; Estimates for 1946-1960* (New York, 1950).

The President's Materials Policy Commission, *Resources for Freedom*, Vols. I to V., (Washington, D.C., 1952).

(b) The rate of growth measured by national product data is inherently overstated for this period by virtue of a transfer of productive activity out of the household (which is not counted) into the market.
(c) The reliability of basic data before 1929 and certainly before 1919 is indeed rather low.

Growth models such as these are not very satisfying. The course of development in investment or capital formation and technological advance—important separate determinants of output in the future—is essentially ignored. Extrapolating the historic rate of increase in output per unit time of labor input implies continuation of the past net combination of capital formation, technological advance and availability of resources. We are assuming the economy will grow without knowing very much about why it is growing. Following the labor input approach we are in a sense imputing to labor the results of investment and changes in technology.

Among the determinants of GNP, only the prospective size of the labor force in 1975 is reasonably certain since a substantial part of it is already born and death rates seem to be relatively predictable. The future course of investment, the rate of introduction and effectiveness of new technology and perhaps availability of raw materials, all more or less interrelated, seem to be the elements of lowest predictability in the prospective growth of real national product.

Long Range Prospects for Food Demand

Within this context of an assumed 1975 economy consisting of some 80 to 85 million in the labor force, with a GNP in 1939 dollars some 55 to 100 or more percent higher than 1950 what are the prospects for demand for agricultural products? In the case of foods, the answers seem somewhat more certain than in the case of the nonfoods, but even here there is considerable room for differences in forecasts depending on assumptions and methods of analysis.

Quantities of food demanded domestically will be a function primarily of such factors as population size, age, and occupational distributions, the level and distribution of income, relative prices of food and nonfoods, progressive changes in tastes and the possible implementation of demands to achieve nutritional goals.

Appraising the aggregate level of food demand and its course over time is subject to some serious limitations in the field of measurement. The matter of the aggregate level of quantity of food demanded as compared with consumption presents difficult conceptual and measurement problems. But even consumption is not immune from varying interpretations. The aggregate of national food consumption consists of a bundle of heterogeneous elements which, when added up in terms of any one com-

mon denominator, give us totals which are incomplete reflections of the aggregate or which may be biased in terms of other bases from which we may measure aggregate food consumption. When speaking of consumption we generally mean purchases, that is, food eaten plus some food waste.

Since 1910 there seems to have been practically no trend upward or downward in the total pounds of food consumed per capita in the United States. The implication of this seems to be that people are consuming about the same poundage of food per person regardless of changes in taste, incomes, and other factors.

Perhaps most of us would not be satisfied with measurement of food consumption on a weight basis, although this is certainly meaningful for some purposes. An alternative has been in terms of food energy consumption per capita. However, strategic items like vitamins do not fit well in this scheme. But food energy is certainly relevant to the amount of work people perform in the process of living and from this standpoint is a useful basis for measuring food consumption. The statistics of food energy consumption on a per capita basis indicate a slight downward trend which is consistent with the gradual decline in human effort required to produce output.

Perhaps as agricultural economists, most of us would be more satisfied with a measure of food consumption based on the value of food consumed rather than any other. The Index of Per Capita Food Consumption prepared by the BAE reflects the combined result of changes in total food consumption in pounds, if that occurs, (and we have found these changes to be relatively small) plus to a limited degree, substitution among foods, particularly substitution between the various food groups incorporated in the index. In view of the relative constancy of the aggregate retail weight of food consumption per capita a considerable part of changes in the per capita food consumption index must be a reflection, therefore, of the substitution of higher for lower (or lower for higher) base priced foods; that is, the effect of income on the food mix demanded.

One serious shortcoming of the index, however, is that within specific food types there is little possibility on the basis of present data available to reflect changes in the value of consumption which result from shifting from lower to higher quality.

An alternative approach to measuring per capita food consumption and appraisal of the effects of various factors on changes in food consumption is through the method of surveys in which measurement is made of food consumed primarily in households by individuals or the family unit. The results of the 1948 Survey as compared with similar studies conducted in 1942 and 1936 indicate a rather substantial increase in the weight of food

consumed in households per capita over these three periods, a result which is inconsistent with the estimates provided by the BAE using national supply data. The changes of the components (in terms of food weight) also are somewhat inconsistent with changes in the components of the BAE index. In general, the direction of change seems to be moderately consistent; the magnitudes in some cases seem to be seriously out of line. However, in interpreting and comparing these two series one should bear in mind that coverage is not identical, and different biases and levels of sampling error are inherent in the estimates. One may, therefore, rationalize some of the discrepancy in these terms.

Thus we are faced with serious problems in measuring actual food consumption. There seem to be important differences depending on the method of measurement used and no measure now available seems to the economist to be a completely satisfactory one.

In appraising the prospects for future food demand I take the following as fact or assumption:

1. The population elasticity of demand for food is essentially 1.
2. The elasticity of food demand in the aggregate with respect to income is low and decreases with increasing income.
3. The elasticity of food demand in the aggregate with respect to nonfood prices is low.
4. The consumption patterns of upper income groups represent increasingly income-free decisions with respect to food purchases and represent to some extent the food-mix goal or target toward which lower income groups will shift with higher per capita and less unequal incomes.

Population Growth and Food Demand

The aggregate level of food demand will be primarily affected by changes forthcoming in population size. A change in population of 10% should not, however, be considered as automatically giving rise in and of itself to a 10% change in the demand for food. A 10% population increase in India might have a quite different effect than a 10% increase in the U. S. There is a rather long chain in the process of food demand materializing out of population growth.[2]

[2] As individuals increase the size of their families, increased food needs will be balanced off against and compete for family income along with other categories of family expenditures. Population increases certainly will mean that more food is needed to get the same level of per capita food consumption. But for population increase to manifest itself in increased food demand the increase in population must be absorbed in the economic system in such manner that it gives rise to proportionate increase in output and this output is distributed among the increased population in such manner that effective demand materializes. Also, in the longer run, population growth is not independent of the course of economic developments. Changes in our economic system may have substantial long-run impact on growth of population which in turn have their effect on changes in our economic system. This mutual interaction would be very difficult to quantify, of course.

Analysis of U. S. data on aggregate food consumption, population and per capita real income indicates that in the past 40 years the population elasticity of demand for food has been very close to one; that is to say that as our economic system has worked out its adjustment to population growth a 10% increase in population has resulted in about a 10% increase in food consumption. I have no evidence to indicate that this situation will be substantially altered in the future. Economists generally assume, I suppose on logical grounds, that increases in population will result in similar increases in the demand for food, although this is not necessarily certain.

Experience with projections of the population during the last two decades has given rise to increasing suspicions regarding the realization of these projections. Demographers have made serious efforts to improve their projections and have made progress in this direction; in addition they have developed more accurate data for recent years. To some who have studied the problem of population projections, however, there is still the feeling that demographers continue to be too cautious in their forecasts for future population growth and are too impressed with the decline in the birth rate which reached its low point in the middle 1930's. At any rate, most population projections today still incorporate among their assumptions a birth rate which will decline in the future.

In the projection of future population most of the variability in estimates arise out of varying assumptions about birth rates. Death rates seem to be relatively predictable and migration relatively unimportant. There are wide differences of opinion, however, about the future course of birth rates. While I do not pretend to be a student of population, I have the feeling that most of the projections understate the prospective course of population growth and implicitly, therefore, I assume that birth rates will continue at near their present levels. Numerous changes in our economic institutions directed at economic security were developed during the last two decades and, of course, employment levels were high. Consequently, I believe the younger families experienced a considerable increase in their security of economic expectations as well as perhaps a sense of urgency associated with the climate of international affairs. Economists advance the notion that the reduction of uncertainty gives rise to increased output, and in connection with population growth and birth rates in particular, I would argue that reduction in the uncertainty of economic expectations has been a major factor giving rise to increased production of children. Regardless of the merits of this hypothesis, I believe there has been insufficient consideration given to the impact of changing institutions upon population growth and until this is done our forecasts are likely to be unsatisfactory.

Projections of the population for 1975 vary from some 180 to 220 million persons. The PMPC assumed the medium forecast of 193 million or an increase of some 28% as a basis for its report. This would mean a prospective increase in food demand of 28%, assuming the population elasticity of demand for food continued to be one. On the other hand, assuming high birth rates continue, a 1975 population of 210 million persons is certainly not unreasonable. This would imply an increase in food demand due to population of almost 40%. Since 1950 our population has continued to increase at a rate consistent with this latter projection which is intermediate between the Census middle and high projections. Consequently in my view there is considerable likelihood that the food demands in 1975 resulting from increased population may be substantially higher than those projected by the Commission.

Food Demand and Income

The heavier food demands that result from increased population are not necessarily the same species as those that result from increased income. Demands from a larger population are essentially for an increased aggregate weight of essentially the same product mix, but demands resulting from increased income are much less for more food than for alteration in the food mix—better quality, more of the 'superior' foods, with much more processing and service. While both sources of increased demand will give rise to increased demands on agricultural resources, the potential claim from population growth certainly will be much heavier than that due to increased incomes.

Estimates of the influence of income on food demand indicate a relatively low elasticity of demand for food with respect to income—somewhere in the neighborhood of .25 to .50. There is little disagreement that the figure is low, but the variation is rather substantial and should be resolved. I suspect that if sufficient account is taken of the differences in economic conditions in which the surveys were taken and if adequate steps were taken to separate out the net influences of family size, meals eaten at home, age, and other factors, many of these differences would disappear. A recent study by Fox of urban household food consumption on a 21 meal at home basis from the 1948 Survey indicates an income elasticity of food demand on an expenditure basis of .28 and of quantities purchased of .14. These results seem to me to be relatively consistent with those derived from time series data.

The recent average income elasticity of demand for food probably has been in the neighborhood of .2 or .3 with elasticities decreasing with increasing incomes. Furthermore, it seems likely that if increases in per capita real income over time materialize and this is accompanied by

further reductions in inequality in the distribution of disposable incomes that the income elasticity of demand for food will gradually approach zero. On these grounds, forecasts of future food demands on the basis of currently estimated income elasticities are likely to overstate the increase in food demand from income increase alone. In the case of individual foods, the estimates may be either high or low depending on the relation between the elasticities at current average income levels and those near the upper end of the income distribution.

With these considerations in mind it is instructive to compare prospective demand in 1975 under several alternative hypotheses. The following table presents the estimates of the PMPC with two alternatives which

COMPARISON OF PROJECTED 1975 FOOD DEMANDS UNDER SEVERAL ALTERNATIVE HYPOTHESES[a]

	1950	1975		
		PMPC	A	B
Gross National Product in billions of 1939 dollars	154.3	308.6	308.6	243.5
Population in millions	151.7	193	210	210
Disposable income per capita in hundreds of 1939 dollars	780	1200	1100	870
Index of Population	100	127	138	138
Index of Per Capita Food Consumption	100	110.8	108.2	102.3
Index of Aggregate Food Demand	100	141	149.5	141
Assumed contribution to demand increases of:				
			Percent	
Population growth		66	77	93
Income per capita		26	17	6
Interaction Pop.×Income		8	6	1

[a] Alternative A assumes a doubling in GNP similar to PMPC but also assumes population growth to continue at near its current rate which is intermediate between the Medium and High projections. Alternative B also assumes this higher rate of population growth with a 57% increase in GNP in 1939 dollars based on 1.6% annual increase in GNP per employed man year with a weekly work time of 34 hours. This is based on the PMPC estimate of the 1975 labor force with their additional estimate of a 15% reduction in hours worked per week. An income elasticity of .2 was used throughout.

involve higher rates of population growth and the same or lower rates of productivity increase, and the same income elasticity of food demand (i.e. 0.2). In each case, of course, population growth is the major contributor to prospective increases in demand with income in real terms having much less and declining importance as the rate of increase in productivity is reduced or assumed population growth increased.

What these prospective demands mean in terms of current farm prices, depend on several other things: the course of money inflation and growth in food output being the main items, with military needs, foreign aid, and marketing costs coming into the picture in relatively lesser roles. In this

connection at least two things should be pointed out. This analysis has been strictly in "real" terms while in fact many if not most economic decisions are made in a context of current and prospective price levels and not so much in terms of dollars of constant purchasing power. Without going into detail on this, I find it hard to conclude otherwise than that our pattern of development will be intermittently pressured by large inflationary surges with subsequent leveling off or even recession (I hope, minor). This leads to the second point (which is mainly outside the scope of this paper) which is that the growth pattern of food output will be affected in considerable degree by the pattern of growth of demand in "current" terms. Obviously, where we will be in 1975 with respect to food demand and particularly food supply will depend on the path we follow. A recent analysis of this race between food supplies and demand has some limitations because it assumed the prospective course of food output to be completely independent of the pattern of development of food demand. A pattern which involves substantial injections of inflationary pressure may very well bring forth a materially higher level of food output than one which is dominated by weak inflationary trends with intermittent recessions. However, this session has apparently been designed so that you individually are left to your own devices in forecasting the prices at which markets will clear under the varying assumptions made in these papers.

The quantity of food demanded has been repeatedly shown to be highly inelastic with respect to price. This is the equivalent of saying that unless price changes of food relative to nonfood are very large, they have little significance for the level of food demand. I am not prepared to forecast the level of food prices relative to the nonfoods, but prospects for supplies forthcoming, a major determinant of food prices has just been discussed. If we can assume that food prices fluctuate within a range of 20% of their current relationships to the nonfoods during the prospective period food demand will be therefore relatively unaffected by relative food prices. So far as the influence of relative food prices on food demand is concerned we shall not be far off.

Effects of developments in nutrition on food demand will probably manifest themselves in terms of slightly modified continuation of past trends in the food mix pattern except in the unlikely case of positive and direct programs based primarily on achievement of nutritional goals rather than alleviation of individual commodity surpluses.

Demand Prospects for Food Groups

Within the framework of a prospective 40-50% increase in demand for food in general, individual food commodities will find markets expanding or even contracting in varying degrees depending primarily upon the

separate income effects per capita, the gradual net time trends in per capita demands and the effect of population growth. The general pattern of past trends in food demand are well known. The gradual downward drift in per capita consumption of grain products, potatoes, and butter have been repeatedly pointed out in various studies and similarly for the opposite trends in meats and livestock products, citrus fruits and fresh vegetables. Somewhat different projections for individual commodities will result from the various approaches and data available for projection purposes. Results of two of these are presented.

One approach for projection of these demands involves the use of budget data combined with the trends in consumption, net of income effects. Assuming that consumption patterns of upper income groups are the result of relatively income-free decisions, these patterns might be regarded as a target toward which the patterns of lower income groups would move as incomes increased and distributive inequality is reduced. These income effects on the pattern of demand then would have to be modified by trend factors which are the result of changed nutritional information, work patterns, etc. Such estimates have severe limitations in the sense of what is 'net' for they are all bound up in the long run in a manner which virtually defies the clear cut separation of net effects.

An alternative approach, subject to similar limitations, would involve a straightforward measurement of past relationships among per capita consumption, real income and trend and their extrapolation, perhaps in modified form based on outside information, in a framework for the general economy.

Following each of these approaches, projections of the 1975 demands for the major food groups have been derived within the framework of relatively high population growth and average rate of increase in GNP.

Aside from the substantial increases in demand in prospect for most of the commodity groups, several additional conclusions seem worth noting.

1. The commodity groups with prospects for greatest demand increases (citrus, tomatoes, leafy green and yellow vegetables) are those which are produced in relatively small areas. The benefits of these largest increases in demand will not be distributed widely.

2. The commodity groups with demand prospects dependent primarily on population growth (i.e. with limited per capita income or trend effects) have wide distribution of production for the most part. (Dairy products, excluding butter, meat, poultry, fish, eggs, fats and oils, other vegetables and fruits, dry beans, peas, nuts, soya products.)

3. Grain products and potatoes have been subject to such significant declining trends in per capita consumption that, if they continue, even after allowing for growth in population, significant declines in demand appear in prospect. With both commodities produced in widely dis-

PROJECTED CHANGES IN PER CAPITA FOOD CONSUMPTION AND AGGREGATE DEMAND FOR 1975, BY COMMODITY GROUPS

	Consumption per capita in 1950 and projected for 1975			Projected change in Demand[a]	
	1950	1975		C	D
		C[b]	D[c]		
		—pounds—		—percent—	
Dairy products, excluding butter	430	452	506	45	62
Meat, Poultry and Fish	162	170	197	45	68
Eggs	48	50	58	44	67
Fats and Oils	68	67	68	36	38
Leafy Green and Yellow Vegetables	117	153	164	80	93
Citrus Fruit and Tomatoes	97	177	163	152	132
Other Vegetables and Fruit	226	241	264	47	61
Grain Products	170	87	91	−29	−26
Potatoes and Sweet Potatoes	112	65	67	−20	−17
Dry Beans, Peas and Nuts	17	20	22	62	79

[a] Under assumption of high population growth.
[b] Based on reduction of one-half in the spread between upper and lower income consumption patterns, adjusted by net trends (significant) in per capita consumption.
[c] Based on average 1922–49 relation between per capita consumption, deflated disposable income per capita and time (where b's were significant at the 1% point) and the relatively high GNP projection of PMPC.

tributed areas, this prospect may well present a major problem in adjustment in the next generation. However, it should be pointed out that the prospects for these trends to continue, is wide open. For example, Cochrane argues that the potato decline will soon stabilize and if so, future demand will depend almost entirely on population growth.

4. The rather substantial demand increases in prospect for dairy products and livestock gives rise to some important questions of adjustment in the livestock-feed economy.

The Demand for Nonfood Farm Products

Analysis of the demand prospects for nonfood agricultural products, primarily cotton, tobacco and wool, presents more difficult problems than most foods, both in terms of data and methods. Demand projections are, therefore, likely to be further astray from actual developments than in the case of the foods.

The extent to which synthetics will replace cotton and wool depend in considerable part upon unknown future technological developments which will affect and perhaps be affected in turn by trends in cotton and wool prices. Estimates by other investigators[3] under high income assump-

[3] Primarily from Black and Maass in Vol. 5, President's Materials Policy Commission, *Resources for Freedom,* and an unpublished report by Rex F. Daly, *Some Considerations in Appraising the Long Run Prospects for Agriculture,* Bureau of Agricultural Economics, U. S. Department of Agriculture, 1951.

tions indicate prospective declines in per capita consumption of cotton of from 8 to 15 percent, and even less agreement in the case of wool with forecasts varying from a 20 percent increase to an 8 percent decline. After allowing for increased population these projections imply demand increases for cotton of from 17 to 27 percent and in the case of wool from 27 to 65 percent.

The future course of tobacco consumption seems relatively more predictable, unless such things as the current efforts to relate smoking to the incidence of lung cancer have a significant effect on current and prospective consumers. Demand increases per capita resulting from a larger proportion of consumers using tobacco and a higher rate of use per consumer have been projected for 1975 by PMPC at 15 percent. The major force in increased tobacco demand then should be increased population, which, under our assumptions would imply a demand increase of nearly 60 percent by 1975.

Estimation of aggregate demand changes using retail prices as weights is relevant to the situation at retail, but the impact of these demand prospects translated to the demand for farm resources probably requires quite a different set of weighting factors. What may be needed here is something on the order of Leontief type inter-industry studies applied to agriculture with knowledge of the likely changes in the coefficients resulting from introduction of new technology into the system. Lacking this, the simplest recourse is to intuitive judgments about relative resource demands likely to arise from given demands at retail for individual commodities.

Conclusion

If I may summarize briefly, it seems to me that in the next generation agriculture will face substantially increased demand prospects and that the major factor for most commodities is prospective population growth. In others, prospective increases in incomes and changes in tastes will magnify and even be more important than population effects. But in several cases population growth may not be adequate to sustain even current levels of demand particularly if past trends continue. These diverse influences will call for important resource adjustments for agriculture as a whole as well as for the relationships among its parts.

LONG RANGE PROSPECTS FOR AMERICAN AGRICULTURE: INTERNATIONAL TRADE*

KARL BRANDT
Food Research Institute
Stanford University

WITH malice toward some, the editors of *The Economist* said recently:[1]

"America is now more amply equipped than any country in history with the material for making crystal balls, and with economists whose whole-time job it is to sit looking into them. This does not mean, of course, that it knows what is going to happen, or that it can ensure full employment for anybody but the economists themselves."

Since I share this wistful skepticism as to the omniscience of our profession, I shall make no use of crystal balls. Who among us believes that he can foresee the world we shall live in ten or twenty years from now—if we may call prospects of such a span "long-range" ones? Foreign trade, after all, is only one facet of world events, which include such overpowering random sources of economic maladjustment as revolution and war.

Further, I shall avoid delving into the theory of foreign trade in its classical, Keynesian, neo-Keynesian, neo-classical, and post-Keynesian manifestations. This is undoubtedly one of the areas of dynamic processes in which economics has been at its best for generations in analysis and interpretation. Most intriguing to me is the American phenomenon: while the case for the freest sort of exchange of goods is clear and convincing, foreign-trade policy has consistently been conducted contrary to the theory on which all economists agree. One often wonders why such great teachers as Taussig, Viner, Graham, and Haberler made so few converts among legislators and civic leaders. They succeeded in advancing public knowledge of the case of foreign trade, pleaded it eloquently among themselves, but never got enough people to the point of voting in accordance with the rational and logical requirements of economic efficiency and maximization of national wealth.

A partial explanation of this situation lies in the fact that members of a human society have many mixed motives for their actions. The desire for economic efficiency, and for improvement in income and wealth, i.e.,

* The author is indebted to his colleagues Joseph S. Davis and Merrill K. Bennett for their helpful discussion, critical perusal, and assistance in applying the *ultima lima*.

[1] Mar. 28, 1953, p. 919.

opportunity and change, is counterbalanced by the desire for security, absence of change, and for convenience, i.e., the status quo. But the explanation also involves failure of action on the side of economists.

Possible Change in Trade Policy

If all signs do not mislead us, our foreign-trade policy has just entered a phase in which a long overdue adjustment is in the balance, ripe for action. This change, in my view, has come about not because the leaders of public opinion have been won over to the cause of freer trade by political economists who have sharpened the issues and brought them into focus, but rather because of the progress that has been made in the development of our industrial economy. The changed situation is clearly indicated by the policy statements of leading industrial, farm, and labor organizations, which plainly argue a case for the maximum flow of multilateral trade. These may not startle economic theorists, but one who really knows how deeply the philosophy of isolation and high protection is rooted in the hearts of the American people can only hold his breath in view of this momentous and unique opportunity. It is as if a glacier were set to change its course; but the enigma wrapped up in a mystery remains: Will that glacier actually bend its course?

After 20 years, the country now has a Republican Administration, which must shape the nation's course within this remarkable setting. This condition accentuates the crucial portent of the problem, and puts the greater burden on all who can contribute to the solution to speak out. Like the Europeans, we still have the trauma of the last depression in our system, and are plagued by the fear of another period of mass unemployment. Since 20th century democracy is incapable of enduring political pressures generated by mass unemployment, and a Republican administration was in the White House when the last depression struck, this party is bound to avoid a repetition of that situation lest it perish.

Cordell Hull's Reciprocal Trade Agreements Act has been extended for one year. The President has appointed Lewis W. Douglas chairman of a committee to investigate British proposals to restore convertibility of currencies. The President is set to appoint a new government study commission to survey the whole of our foreign economic policy. This is why I shall try to come brutally to grips with two questions of practical economic policy: (1) Why is American protectionism still strong enough to threaten a worsening in the maladjustment of world trade? (2) What must and can be done to win the battle for freer trade and for adjustment in the balance of payments? I shall present an unorthodox, pragmatic program of action, analyzing both questions from the standpoint of American agriculture in the long run.

It is my underlying conviction that the development and performance of international trade are governed more than anything else by the economic policies of the few major industrial countries, just as the domestic economy's performance is primarily shaped by the economic policy decisions of its government. In other words, foreign trade is action in which nations engage with responsibility—it is not a reflex response to God-given changing circumstances. In this connection it is important to see the responsible position of our nation in true perspective.

American Responsibilities

By the sheer magnitude of its industrial production, its dependence on raw-material imports, and its creditor position, the United States has become the prime mover in the world economy. By her policies and fortunes, America affects the well-being of many nations for better or for worse. This being so, I am appalled, time and again, by the disparity between the chances for our country to improve conditions in the world by courageous decision and backed by the innate honest desire of Americans to do so, and the actual pragmatic failure to live up to the challenge. The remedy lies in grasping firmly our opportunities and moral obligations, in reaching a synoptic understanding of the causal relations between our policies and the shape of world affairs, and in co-ordinating our domestic and our foreign policies.

After having decided World War I, the United States determined the political course of the reconstruction of Europe, and American private capital financed a great deal of the economic recovery. But instead of consistently playing our part as the world's great creditor country by buying more goods and services, we twice raised our tariffs, preferred short-term aid to trade, and by thus financing our exports contributed a great deal to the imbalance of international trade. When all this came home to roost, we belatedly granted the Hoover moratorium; and under Franklin Roosevelt we retired further and further within our four walls despite Cordell Hull's efforts. In 1933, trying to pull out of depression at home, we blew up the London World Economic Conference by refusing to commit ourselves to a program to stabilize world currencies. In my view, if we are to be assessed any share of the responsibility for failing to prevent World War II, it was in those prewar years when we were so deeply concerned with domestic affairs that we were blind to issues of foreign policy.

When we were deciding the outcome of World War II, again with the power of arms, our in-alert leaders offered the Soviets the opportunity to gobble up a large part of Europe. But following this tragic diplomatic

blunder, we began to rebuild what was left, investing in that action extraordinary funds and effort.

We plowed some $30 billion into Great Britain, France, and other countries, not counting many billions of dollars spent through our military forces, and have the satisfaction of seeing our exports boom and the West-European economy reach a stage of full economic recovery. This year its industrial output is 50 percent above the prewar level.[2] However, let us not forget that, in 1928 also, Europe's productive capacity had been rebuilt and full employment prevailed in industrial countries. Yet this was the time when the world agricultural depression began—the forerunner of the industial depression that broke out in the United States. Thus one wonders if there is a pattern of cyclical behavior in American foreign policy: national security threatened from abroad, war, destruction, victory, reconstruction of enemy territory, retreat, and back again to the threat to national security.

Since the war we have made many constructive moves toward greater stability and international economic co-operation. As initiators of the United Nations, we have taken the lead in creating the World Bank and International Monetary Fund (IMF), have taken steps (thus far futile) to create an International Trade Organization (ITO), have drafted the General Agreement on Tariffs and Trade (GATT), and have set in motion the Organization for European Co-operation (OEEC) and the European Payments Union (EPU). We have also lowered some tariffs[3] and launched the technical assistance program. Yet the international situation is a long way from being one that assures stability of economic growth or free intercourse among nations.

As a result of the cold war in general, the now tepid one in Korea and the hot one in Indochina, the world is cut into two major areas: the Soviet empire, with roughly 800 million people, and the free or non-Soviet world, embracing 1,500 million people and the major part of the earth's industrial capacity. The trade that goes on between these orbits of power is merely a trickle compared with what it could be in the absence of the prevailing hostility. Basic to this restriction is the Soviet strategy of maximum autarky within the Soviet bloc. But to a considerable extent, trade with this bloc does not flow because security considerations have led the West to lay embargoes on exports to Russia and her satellites

[2] Cf. Organization for European Economic Co-operation, *Europe—The Way Ahead: Toward Economic Expansion and Dollar Balance* (Fourth Annual Report, Paris, December 1952).

[3] Under the Reciprocal Trade Agreements Act the weighted average of U.S. import duties has been lowered from 1934 to 1952 from 25.8 percent to 13.3 percent. However, the lower duties concern a good many unimportant items, while many tariff rates for significant commodities are still prohibitive.

—embargoes which are enforced to the full in the countries which we still occupy, i.e., Germany and Austria, and in a number of other countries which rely mainly on our support, such as Japan.

The free world is again split into two regions, one with "soft", the other with "hard" currencies. The main body of the latter consists of the dollar area, with the United States as its center, and includes those other countries most of whose foreign-exchange receipts are derived directly from the United States, and whose exports to other countries consist largely of essentials. The principal countries conforming to this definition are Canada, Mexico, Venezuela, Colombia, and the Republic of the Philippines;[4] but Switzerland and Belgium are also hard-currency areas. The soft-currency areas are composed of the sterling bloc and the remaining countries. Soft currencies are not inter-convertible, and trade under foreign-exchange controls suffers from the resulting impediments.

The free world has made great progress since the end of the war. The dollar value of world trade has risen to three times the prewar figure. From 1947 to 1952 United States imports of goods and services have increased from $9 billion to $17 billion ($11.5 billion in goods; $4.2 billion in services). The General Agreement on Tariffs and Trade, concluded in 1947, has served as a most useful instrument among the 34 participating countries in their efforts to improve trade conditions in a combined area which accounts for over four-fifths of world trade. But this volume was possible only with the aid of the United States, which covered the free world's dollar deficit—it reached its peak of $10.6 billion in 1947, and from 1946 to 1952 amounted to $34 billion, not counting the aid given through military channels. About $30 billion was made up by American aid, and $4 billion by gold and dollar reserves. By 1952 this deficit had shrunk to $1.5 billion. But the reduction was achieved only while several billions of dollars in military aid were being granted to European countries, and a multitude of restrictions on imports were in force within the "free" world. Thus we now have a volume of trade which is smaller than what could have been achieved, and a balance of payments in which the United States in 1952 still had a net surplus of $5 billion.[5]

Trade Still Hampered

Tariffs have been lowered within the free world, but foreign trade is being regulated by many countries through foreign-exchange controls, licenses, import quotas, export embargoes, and processing taxes. It is

[4] United Nations, Department of Economic Affairs, *Economic Survey of Europe Since the War. A Reappraisal of Problems and Prospects* (Geneva, 1953), p. 14.

[5] Cf. Bank for International Settlements, *Twenty-Third Annual Report* (Basel), June 8, 1953, p. 5 ff.

being further impeded by bureaucratic customs chicaneries and paper warfare. These obnoxious quantitative and monetary controls serve mostly the purpose of establishing a kind of equilibrium in the strained balance of payments, with exchange rates fixed at artificial levels. But they are also used as tools of economic nationalism; and this is the sad inheritance we have from the years preceding the great depression. Trade moves today largely on the basis of bilateral agreements, and an imbalance of clearing accounts with further quota restriction is the result. Bilateralism as such is a system of fettering trade, and is not "international trade" in the true sense. It is, in fact, an attempt to transform international trade into internal trade.

While the value of trade has increased, the monetary reserves of most of the note-issuing banks are inadequate, and the action of the IMF has proved wholly inadequate. Some progress is being made in removing difficulties of payment between countries and reducing quantitative restrictions. The Organization for European Economic Co-operation (OEEC) has in particular liberalized intra-European trade, by gradually removing quotas, though in a see-saw fashion, with spells of deliberalization. The EPU has established multilateral clearing arrangements for Western Europe, the sterling area, and Indonesia. And in 1953 the Coal and Steel Community (Schuman Plan) has to some extent freed the market for coal and steel in six Continental countries (Belgium, Holland, Luxembourg, France, Germany, and Italy), although, owing to tax differentials imposed by each country on domestic or imported coal and steel, there is by no means a free market yet for even these two commodities.

Notwithstanding the progress that is being made in removing some of the impediments to international trade, the situation is far from stable, and the strategies of the major Western countries are neither united nor in accord one with the other. There have been recurrent balance-of-payments crises in Great Britain and countries on the Continent—in 1947, 1949, and 1951. After the Marshall Plan expired, we shifted to Mutual Security aid under the NATO defense effort, but our aid is tapering off rapidly. It is our national goal to reduce spending on rearmament in the United States from $50 billion to something like $35 billion by 1956. This puts on the deficit countries the burden of balancing their trade, and we are already beginning to feel its impact on our agricultural exports, in addition to the effect of agricultural recovery and of protectionism.

The European countries are apprehensive about the deflationary effect that the slow-down of our public spending may have upon the volume of imports. British fears have been voiced in a series of articles entitled "If America Slumps,"[6] which demonstrated that when United States gross

[6] *The Economist* (London), Mar. 28, 1953, pp. 917-28.

national product fell in 1938 by 5 percent, the value of United States imports from the overseas sterling area fell 50 percent, and when in 1929-32 our national product declined more than 40 percent, the value of imports from the overseas sterling area fell over 80 percent.

The pace and degree with which the new Administration initially tightened the monetary policy are occasion for great concern because, if maintained, they too will lead to a deflationary contraction in the volume of business. We cannot shirk responsibility for the international repercussions and chain-reaction effects which the course of our domestic policy entails—even for such ominous contingencies as foreign revolutions and war.

At the moment, these premonitions of rainy days ahead, after a business chill in the United States within the next three or four years, lead the non-dollar-area nations to acquire as much gold and as many dollars as they can, and to hold them in monetary reserves as an umbrella for the expected downpour. This precaution reduces our exports and strengthens the soft-currency countries.

The following data on the gold reserves and short-term assets show, in billion U. S. dollars, the approach toward equilibrium in the relationship between the various economies of the world:[7]

Area	End 1949	End 1950	End 1951	End 1952
Sterling area:				
United Kingdom	1.9	3.6	2.8	2.3
Rest of sterling area	.8	.9	.9	.9
Total	2.7	4.4	3.7	3.2
OEEC countries (other than U.K.)	6.0	6.6	7.0	8.2
Canada	1.4	2.0	2.2	2.5
Latin America	3.1	3.5	3.4	3.4
Asia	1.5	1.9	2.2	2.4
All other countries	.7	.8	.8	.8
Total gold reserves and dollar holdings of countries other than the United States	15.4	19.1	19.2	20.4
U. S. gold stock	24.6	22.8	22.9	23.3

At the moment we are losing gold at a fair pace as foreign buyers of our exports hold back. Agriculture stands in the forefront of the present change in foreign trade. Our agricultural exports climbed from a prewar average of $750 million to a postwar peak of $4 billion in 1951/52, with 30 to 40 percent of our wheat, cotton, rice, and grain sorghum being exported, as well as 20 to 30 percent of our tobacco and soybeans. We

[7] Bank for International Settlements, *op. cit.*, p. 6.

imported about $4 billion worth of agricultural products from 1949 to 1951.

With the reconstruction of world agriculture well-nigh complete, particularly in Europe, competition for cotton and wheat from other exporters has revived, and European countries are using their bargaining power in bilateral long-term contracts. Our agriculture has to face an adjustment to this changing demand situation in the world market. The 12 golden years of a seller's market in farm products are over, and the terms of trade for agriculture are becoming less favorable. If our domestic economy, with its increasing population, continues to maintain a high level of employment, and if productivity per man hour continues to increase—if, in other words, the effective demand, instead of slackening, in the long run expands—then the adjustment to a smaller foreign demand should economically be no more than a transitional problem. In politics this means that in all exporting countries farmers will turn the heat on their governments for remedial action. This is certain. What remains to be seen is the course of action that our government will take.

Will our farmers adopt an autarkic and isolationist philosophy of deliberate retreat from the world market? Will they take refuge in cutting their output to the domestic market, and manage the contraction of the volume through federal agencies as they did in the 1930's?[8] If this comes to pass, efforts will be made to reduce the imports of supplementary products, which in 1951/52 amounted to $2 billion. It will also mean that agriculture will try to compensate for the smaller volume by high support prices at home, with the production and market quotas that inevitably go with them for many products, and governmental controls of increasing scope.

If, on the other hand, agriculture should set its sights on national efficiency, comparative advantage, and on competing in the world market, it must, after making the necessary adjustments, pursue an elastic price and supply policy. Success in exports makes all adjustments much more manageable, and gives the farmer a chance to take a good measure of them upon his own shoulders. I have no doubt that in its present excellent shape American agriculture could successfully compete in a free-exchange world as to both quality of product and price.

The Road Ahead

A course of emancipation from the world market will eventually defeat the nation in its foreign as well as its domestic policy. The Public Ad-

[8] One must not overlook the fact, however, that the index of the quantity of U. S. agricultural exports (1924-29 = 100), the 1930-33 average of which dropped to 75, never fell below the 49 mark it reached in 1934. The 1935-39 average stood at 60.—

visory Board for Mutual Security, which numbered among its 14 members the presidents of the chief farm and labor organizations, stated the case clearly in its trade-policy study of February 1953 (the so-called Bell Report):[9]

"A sharp conflict exists between reducing tariffs with reciprocal trade agreements and retaining tariff rates of 25 percent, 50 percent, or even more on numerous manufactured goods; between giving billions of dollars in aid to put Europe on a paying basis and adding a rider to the Defense Production Act embargoing imports of a number of agricultural products; between insisting on security controls by the free world on exports to the Soviet bloc and denying the free world the access to United States markets which would decrease their trade dependence on the Iron Curtain countries; between providing loans and technical assistance for development programs in underdeveloped parts of the world and levying penalty duties on the processing of the raw materials they sell in this country."

These are strong, clear, and courageous words uttered by conscientious leading citizens. Obviously, if we do not ourselves resolve these contradictions, the other countries will inevitably adapt their own policies to them, thereby protecting themselves against damage. Such adaptations will be painful to all concerned, most of all to us. One adaptation will lie in non-fulfillment of the share in the mutual security system meted out to the countries in question, and in their pulling further away from the close alliance with us which we all so sorely need. Another will consist in restoring trade with the USSR, tightening relations within the sterling area and the EPU, and sharpening methods of combating American export goods and services.[10] Even Germany, Austria, and Japan will trade with the Soviet bloc if our markets are closed to them. Significantly enough, the United States government has just consented to the Japanese export of sheet metal and other forbidden goods to Red China. If Europe cannot trade enough with the West, it will trade with the East, too.

The clue to the solution of specific commodity problems, such as those which surround cotton, wheat, tobacco, or rice, lies not in commodity policies but in the course of general economic policy, particularly its monetary and fiscal ends. The key to our agricultural-export and -import policy lies not in agriculture, but in the general area of foreign commerce, including our monetary policies and financial relations with other nations, primarily Europe.

U.S. Dept. Agr., Foreign Agricultural Service, "United States Farm Products in Foreign Trade" (1953, Statistical Bulletin 112), p. 9.

[9] Public Advisory Board for Mutual Security, *A Trade and Tariff Policy in the National Interest* (Washington D.C., February 1953).

[10] Cf. International Monetary Fund, *Fourth Annual Report on Exchange Restrictions* (Washington, 1953).

If we exclude a resumption of buying gold at a high fixed price to bury in Kentucky vaults, we face several basic alternatives if we try to maintain a high volume of industrial and agricultural exports while maintaining a heavy foreign-trade surplus. *First,* we can continue to grant aid—perhaps by paying other nations for part of their share in the Mutual Security System as we do now. We can also try to give away commodities under various titles of relief or charity. This tends to keep the other nations dependent on us. But make no mistake—deep in their intestines they all profoundly resent this trap, and eventually they will break out of it, no matter how high the cost. Moreover, the policy of giving away surpluses is not possible on a large scale, because it is the worst sort of dumping and leads to retaliation by those competitors who are hurt by it. Euphonious labels like "two-price system" make no difference.

Second, we can increase our capital export—that is, foreign investment and long-term foreign lending, thereby closing the dollar gap. But if this is in reality to be investment, and not just another form of giving away goods, it will shortly lead to the need for accepting payment of earnings and eventually of some principal which can take only the form of gold, or of goods and services. Further accumulations of gold increasingly upset the balance of payments via monetary reserves, and lead to further trade restrictions. Hence it all comes down to more American purchases of goods and services.

If we are striving for peace and security in the world, we must, in addition to being armed and alert, lead in realistic efforts toward an expanding economy everywhere that will improve the welfare of all peoples. This can be achieved only by live-and-let-live co-operation among the leading nations of the free world in their domestic and foreign policy. To be sure, even if we want to do so, we alone cannot close the dollar gap; the deficit countries must do their part in energetically adjusting their domestic and foreign policies to this goal and avoid inflationary pressures at home. But neither can they do this alone, and this puts an extraordinary moral obligation on the United States in its leadership position.

The slogan "Trade—Not Aid," which Chancellor of the Exchequer Butler coined, has a mighty ring throughout the world, and if one takes their words at face value, the leaders of public opinion in the United States accept the slogan in principle. The change, to a policy of trade from one of aid, involves on our side the obligation to increase our purchases of goods and services from other nations. It means that we must reduce or eliminate customs duties and the more vicious quota restrictions, abandon the escape clause in the GATT, abolish the Buy-American Act,

simplify our often stifling, outrageous, and hostile customs procedures,[11] remove subsidies on United States shipping, and liberalize further the free-import limit for United States citizens who return from travel abroad.

It also involves a steady hand at the steering wheel of our domestic economy, particularly with reference to fiscal policy. If we avoid any sudden jar in the volume of business, we must maintain an atmosphere in which the shift from less and less aid to more and more trade *can* be accomplished, and the ultimate liberalization from foreign-exchange controls reasonably envisaged. Convertible currencies will be the symptom that international trade has been freed. One cannot reverse this.

Protectionism is Intrenched

But it is my most reluctantly formed impression that despite all the lip service paid to "Trade—Not Aid" in this country, most of those who ultimately decide our economic intercourse with the world still prefer aid to trade—much as they loathe the perpetuation of aid. If they have a choice, they really prefer no aid and as little trade as comfort will allow. American protectionists have already launched their counter-offensive. They have formed the "Nationwide Committee of Industry, Agriculture, and Labor on Import-Export Policy." With ample resources at its disposal, it will harass the President, Congressional committees, and the public with the old "coolie-wage" argument and many another dressed in new garb.

This attitude stems from understandable motives which are firmly anchored in American tradition. I am afraid we shall not resolve the contradictions in our policy soon enough, unless we recognize these motives and deal with them in matter-of-fact fashion. *To industrialists, local labor-union chapters, and many farmers, aid (i.e., grants, loans, and gifts of commodities) hurts less than trade, because the cost of aid is borne by the nation generally. But if and when trade hurts, it hurts specifically and individually.* The lowering and removal of long-established tariff protection strikes at specific industrial plants and specific producer groups in agriculture.

The economic answer, of course, is that enterpreneurs ought to adapt to the situation by diversifying their products or changing over to entirely different products—in certain industries, even shifting their location. Whether this can be done in the time available depends on the nature

[11] Cf. the case of the American publisher who bought 100 tons of book paper in England, cited in Henry Ford II's Chicago address of February 17, 1953, "The Free World Can't Trade on a One-Way Street" (Dearborn, 1953), pp. 17-18. Congress recently passed an act for this purpose, which represents a beginning.

of the enterprise, the proportion of fixed capital and its degree of adaptability, and other highly complex circumstances. While there can be no doubt that such adaptation is possible in most instances, there are residual cases of which this is not true, where a considerable amount of capital must be written off. If the enterprise cannot be adapted to new profitability out of which depreciation can be carried, this simply means that some capital will be lost and, in specific cases, the loss may create extreme hardship.

From many discussions I have had in Europe and in various parts of the United States with industrialists, farmers, and representatives of labor, I know all of them to be professed free-traders, heart and soul—that is, speaking generally. But nearly all of them inject one small reservation: of course, they say, in their particular business the situation is different; they must have protection against price undercutting on the basis of the much lower living standards and "coolie wages" or unfair natural advantages, or lower production costs that prevail in the countries of their foreign competitors. In the aggregate, these little reservations mean a solid endorsement of protectionism, because most of the voters take care of their own interests at the ballot box; and fear of uncertain risks, though not a good counselor, is a powerful persuader.

If we may correctly assume that to lower or level the fence around our market entails a substantial gain for the welfare of our country, while it will mean hardship to certain groups and to certain individual entrepreneurs, then the whole issue becomes one of equalization between the two.

As we have shaped our nation's foreign-trade policy in the past, and considering the assignment we have given to the agencies responsible for the various aspects of our policy, we have assumed that the national interest can never be larger than the sum of the interests of all individuals and groups. Moreover, we have adopted the principle that no concession made to foreign countries or producers must hurt individuals or groups in our nation. This is the chief argument presented to support all supplementary forms of protection for labor and capital which we apply, the escape clauses in the GATT, and the Buy-American Act. This explains also why, after having promoted the ITO, we killed it before it could be founded.

In our political processes, the institutional setup protects the status quo, which happens to be protectionism. In our Congress, seniority determines the chairmanship of committees. Hence these committees are guided by Senators and Congressmen some of whom have long bathed in the protectionist tradition. It may well be that many civic leaders and a great many voters are considerably ahead of their federal legislators.

Countering Protectionist Fears

We cannot fulfill our obligation to our country's intelligently interpreted interest and our moral obligation to other nations unless we overhaul our foreign and financial policies according to the ruling principle of national welfare. Since the real political roadblock that must be removed is the fear of damage, one of the practical methods of dealing with it is to employ the insurance device of underwriting the risk of damage that may be caused by opening our markets more widely to foreign competition.[12]

This is a deliberate compromise for the sake of winning the necessary political support of a policy of gradually removing tariff walls according to a fixed time schedule. It requires the establishment of the principle that individuals and corporations have a right to indemnity, and that claimants have a right to due process for adjudicating their claims. The federal government should recognize that to lower protective tariffs of long standing against foreign competition in the American market may create for certain persons or enterprises a situation making it impossible for them to operate with a profit or to regain the opportunity by making adjustments that would not mean a substantial loss of invested capital. Further, the government should offer an indemity to owners of invested productive capital if they can prove that the investment a) was interest-earning; b) had ceased to earn interest owing to the impact of foreign competition resulting from the abolition or weakening of protective measures; and c) cannot regain profitability through the owners' adjustment of operations.

I am well aware of the enormous complexity and range of problems that would arise in the process of fairly and equitably judging whether or not claims merited indemnification. Yet we are continually solving equitably problems just as complex.

The analogy which convinces me of the practicability of the principle of equalizing conflicts between national and individual interests is the exercise of the law of eminent domain by the state in acquiring private property for public use. Our whole economic system is solidly anchored in an ironclad protection of title to property by individuals or institutions. Our courts uphold title to such capital to the limit. Yet in our dynamic economy, with the expansion of public services, military forces, public utilities, highways, and common-carrier pipe lines, our local, state, and federal governments continually encroach upon private title to capital in the form of residential, agricultural, industrial, and commercial real

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[12] Cf. the author's earlier proposal of indemnity as a means toward tariff reduction in *The Reconstruction of World Agriculture* (New York, 1945), pp. 294-96.

estate, after payment of compensation to the owners of the capital. The reason for payments of this sort of indemnity to compensate for the loss of a big bundle of functional rights and opportunities, caused by a change in public policy, is the same that makes for providing a similar indemnity for capital lost owing to a change in foreign-trade policy—that is to maintain an atmosphere of relative security vis-à-vis public policy by compensating for the undesired but inevitable damage done to property owned by individuals and groups when the policy is changed. Moreover, it paves the way to necessary swift and effective acceptance of public policy changes, since the offer of indemnity lowers resistance to the idea of change. These were the factors that operated in Great Britain when slavery was abolished—a change in an institutional framework, i.e., that of labor contracts. The same reasoning applied in various other countries when changes were made in the taxation of alcohol and in the utilization of mineral resources.

Those who dismiss the indemnification proposal as an unjustified pampering of capital may believe that with sufficient promotion they could overpower at the ballot box the opposition of those who fear losses. Perhaps they are right, but they reckon without the long interval of delay that is involved, and forget that in this interval the impact of continued United States obstruction of balanced international trade will distort the whole course of economic and diplomatic action by other leading world powers.

Compromise for the purpose of protecting a sound principle seems to be in the democratic spirit of practical common sense and fair play. For many years I have held the opinion that the controversy between the butter and margarine interests could have been resolved for the benefit of the nation and both contending parties by means of a practical compromise. In that issue, those advocating the unconditional surrender of the protected butter industry by majority vote have won their case, but it took many years of delay, and it has had many subtle but still painful repercussions.

Within agriculture, certain types of production typically involve a heavy investment of long-term capital per acre, while cost structure and output are inelastic. Such enterprises are therefore particularly sensitive to major changes in the market. Fruit and nut orchards, and vineyards are good examples. This is why almond growers are such articulate opponents of any relaxation of tariff restrictions. In terms of national income from agriculture and the stake that lies in a greater volume of foreign trade generally, the consideration being given to these borderline cases is out of all sensible proportion. Fortunately it is not true that these exceptionally inadaptable types of industrial and agricultural production

represent a large segment of our economy, or that all such enterprises have no opportunity to diversify or to shift to alternative utilization of their resources. In the instances of real hardship, indemnity payment would help them make those adjustments.

A federal commission might form the necessary institution to accept and adjudicate indemnity claims. The commission's staff would be responsible for evaluating the evidence presented by those claiming loss and requesting the indemnity. The philosophy pervading such a body, of course, would have to be different from that of the U. S. Tariff Commission.

It is probable that after a sharp curtailment of customs duties, a considerable number of claims would be filed. However, it appears to me just as likely that, after due process of law had once been applied, the aggregate of all indemnities would be relatively small in terms of the gain in national welfare. Moreover, whatever lump-sum indemnity was paid would be invested, and thus would function basically as a temporary support to economic adjustment.

Tariff protection saps national wealth every year. The payment of indemnity would fall due but once. The gain from foreign trade flows continually and is cumulative. How this accumulation works is best illustrated by the excess of exports, which from 1914 to 1952 climbed to a total of $120 billion.

If such a compromise could be made the law of the land by our Congress, it could whittle away a certain part of the powerful opposition to tariff concessions and win the battle for a complete revision of our foreign-trade policies.

Even if this were achieved, there would be no guarantee that the countries of the free world would soon come to the point themselves of abolishing all quantitative restrictions on foreign trade and foreign-exchange controls. Nor is there any assurance that the geographical imbalance between raw-material exports and finished-goods imports, in which we play a considerable role, will soon disappear. But the necessary adjustments would become more manageable, and our bargaining power throughout the world would rapidly increase.

The real burden of my argument lies in the leverage which such a policy, if pursued by the United States, would exert upon the commercial policy of every other country. The experience of the inter-war years during which the world slid into depression showed that every form of restraint of trade in one major industrial country leads by chain-reaction to a similar or even more violent spasm of autarkic measures in all the others. But when the largest exporting nation of all opens the gates to her

domestic market in exchange for similar action, all the other nations become disposed to do likewise.

Other Programs Needed

Let us suppose for the moment that the unexpected occurs, and that trade becomes more open, and that at the same time the threat of another world war abates and national spending on armaments is substantially cut. Then the question would be whether the slack in the demand for heavy construction materials and durable goods could be taken up by improved demand in international trade. Unless a co-ordinated, large-scale effort were made to get a heavy flow of capital investment from the surplus countries into the raw-material-producing areas whose economic development has been lagging behind, the slack probably would not be taken up. The same principle that has carried the development of human civilization since Roman times (not just since the end of the Middle Ages) still holds today—the development of colonial areas by investment from mother countries; and it holds with respect to capitalism as well as to Communism.

Private American foreign investment is now flowing at a rate of $800 million a year, and most of it is going into the development of petroleum resources. If this flow could be increased three- or four-fold, it would give an extraordinary boost to economic development and trade. What has expanded the European economy in the last eight years to a 40 to 60 percent increase in output over prewar years has basically been the investment capital taken out of ECA and MSA aid to the tune of $3 billion a year, some of which was channeled through the United Kingdom into investment in areas like India and Malaya.

But investment with no opportunity to receive earnings in goods or services is merely a stop-gap. Consequently, aside from the impediment of very high yields on domestic and Canadian investments, and a high risk in many countries, this capital can flow only if our trade policy is revised. If, in Soviet style, our foreign policy should in the main steer a course of keeping development and foreign investment of American capital confined chiefly to a Western Hemisphere "bloc," we would drive Europe eventually into further war, revolution, and totalitarianism—and, in the end, into the arms of the Soviets. If British policy pursues, also in Soviet style, only development within the Commonwealth area, the effect upon the continent of Europe will be the same.

What the so-called free world needs, if it is to regain freedom, is not intra-regional trade but a universal system of free, multilateral trade. The sensible course for the British and ourselves would be the closest co-

operation with the industrial countries on the European continent in keeping the expansion of their economies going strong by developing the great raw-material areas of the free world. The products and markets of these areas are badly needed for the peaceful growth of productivity in the world economy, and for the conquest of poverty in the revolution-pregnant areas themselves. If, instead of running wild with enthusiasm over national independence for all sorts of would-be splinter states, we were to see to it that economic development gave the people a chance constructively to use their energies for their own welfare, we would truly be advancing the cause of peace. What counts is rise in real income according to the standards of the people concerned, not equalization with United States per capita income.

To wind up my argument, I shall point to the leeway for American foreign trade in agricultural commodities under the assumption that in the balance we will relax our foreign-trade controls and not tighten them. In prewar years (1935-39) Western Europe received 67 percent of the value of American agricultural exports. In 1946-50 it received almost exactly the same proportion—69 percent. In 1951/52 the European agricultural import deficit amounted to 22 million metric tons of grain, 3.5 million tons of fats other than butter, 360,000 tons of tobacco, 3 million tons of sugar, 800,000 tons of meat, and miscellaneous other products. From these facts I conclude that Europe will potentially be the buyer of a large part of our agricultural exports, particularly grain, cotton, and tobacco. With a still growing population, it will buy more grain and fibers and perhaps more fats as well from us, provided its economy expands and its per capita income increases, and provided also that it can earn the dollars in exports to us and in selling services such as transportation, tourist accommodations, and insurance. As a further proviso, we would need to have a reasonably elastic price policy that would keep our commodities at competitive price levels.

While there may be some international commodity agreements in operation (such as for wheat and sugar) they will not play a major role in stabilizing world markets. Similarly it can be taken for granted that neither national nor international stockpiles will be used toward that end. Their destabilizing impact when the boards that run them stop buying or begin buying at the wrong time has become all too apparent.

We have no reliable device for measuring the actual elasticities of the demand in international trade, nor can we forecast the volume of imports and exports in the event of a new trade policy. But we should consider the fact that elasticities in foreign trade also are a function not of wholesale prices at sea but of retail prices to the ultimate consumer. This obviously involves world-market wholesale prices plus freight, insurance,

customs duties, processing and excise taxes, and whatever other fees may be imposed. Elasticities in international trade involve a time factor. After conditions for exporters and importers improve, they and all links in the chain from producer to ultimate consumer must be given a chance to adapt themselves to this new situation. Furthermore, the American market represents an exceptionally vexing problem of merchandising by its mammoth area and capacity alone. Advertising requires a large capital outlay. If it succeeds, the demand overshoots the supply, and the demand for a specific foreign brand or quality of a commodity will slump if the producer cannot respond quickly enough.

What I have said concerns our freedom of action. I cannot be accused of having any ambition to be right as to what will happen. The skeptic and the pessimist often have the best chance of being right in their forecasts. But if man has made progress, it was not achieved by cynics or by determinists. Believing that political economy is an applied science that deals with every man's and every nation's problems, and must contribute to the solution of those problems, I feel that it is our—the economists'—duty to get the course of the glaciers changed. If we have not succeeded in getting the nation to apply our knowledge, it is because it cannot be done through professional journals or in classrooms and seminars alone. It requires the closest co-operation and a constant exchange of thought in an atmosphere of mutual respect with farm and business leaders, Congressmen and Senators. We have made great strides in this in recent years, but it is merely a beginning. With orientation from our profession, American farmers ought to put their full service as conscientious citizens and their great political weight into the scales when the President's commission on foreign trade explores the terrain for a thorough revision of our anachronistic and paradoxical foreign-trade policy. In doing this, they must weigh most carefully what they deliberate in their co-operation with Secretary Benson's committees on the revision of our agricultural price and market policies.

We must not overlook the fact that all the national controls on trade and goods and services, and on the movement of people, know-how, and capital cannot keep the political and social pressures in this highly dynamic world in check; if their release is carefully prepared, these energies can be put to work for a viable peace. But while the world is dynamic and changing, the nature of the problems changes very little. Henry Wallace's little book, *America Must Choose,* is just as timely today as it was 20 years ago.

FREE MARKET PRICES AND RESOURCE ALLOCATION

Chairman: E. L. Potter, Oregon State College

THE EFFECTIVENESS OF FREE MARKET PRICES IN ALLOCATING RESOURCES WITHIN AGRICULTURE

E. J. Working
University of Illinois

THE title of this paper is not of my own choosing. I was asked to speak upon the subject as stated. I suppose that means that the subject was chosen by our president as a good one to start an argument. Of course he might not want to put it that way. He might prefer to say that the subject is one which lends itself well to discussion—and so it does.

At the outset, I should like to point out that one's views as to the effectiveness of free market prices in allocating resources within agriculture may depend in no small degree upon how he interprets the words "free market prices." When we speak of free market prices, do we mean prices that are free of controls or prices that are free to change? If free of controls, do we mean free of government controls alone or also of private controls? If free to change, do we mean free from all the economic "frictions" such as custom and price contracts, which extend over time, as well as free from things which are obviously designed to prevent prices from varying such as "fair trade" pricing?

These distinctions may seem to have little applicability to agricultural prices inasmuch as agricultural prices are almost universally both free to change and free of controls except as they are subject to some sort of government-maintained price controls. But when we speak of prices as a means of allocating agricultural resources we must surely consider relative prices. We must be concerned not only with the exchange value of agricultural products, one with another, but also with the exchange value of agricultural products relative to nonagricultural commodities. If agricultural product prices are "free" while many nonagricultural prices are not "free," are the relative prices of agricultural products established under free market conditions?

Although this paper is concerned with the allocation of resources "*within*" agriculture, we must remember that this allocation depends not only upon prices of agricultural products, but also upon prices of other products. Thus, whether the power used in producing farm products is produced on the farms or by other industries must depend upon the rela-

tive costs of the two sources of power—not only upon agricultural prices and wage rates, but also upon nonagricultural prices and wage rates. Time was when almost all the labor contributing to the production of wheat was performed on farms. Now, a large share of the labor is done in factories producing combines and tractors or in the oil fields producing fuel and lubricants. The output of cotton, hogs, cattle, and other agricultural products is likewise dependent not only upon the labor of farm workers, but also upon the labor of workers in factories, oil fields, railway trains and many other places. Hence the allocation of resources within agriculture is partly dependent upon the allocation of resources outside agriculture. Insofar as allocation is affected by prices, it is affected not only by the relationships of agricultural product prices among themselves but also by prices in other sectors of the economy.

We must recognize, then, that the question of what the allocation of agricultural resources would be under conditions of thoroughly free prices is largely hypothetical. Though we go back to the first thirty years of the current century—or even beyond—our observed data of prices and the allocation of resources are the result of only partially free prices. The degree to which prices of the past may be said to have been free depends upon our definition of free prices, but even before the turn of the century there were some prices that were clearly subject to monopolistic controls and some prices which were governmentally controlled in order to cope with monopolistic situations. Imperfect allocation of agricultural resources may result from lack of freedom in other sectors of the economy. It may result from other causes which neither free prices nor controlled prices can overcome. Prices, of course, do not allocate resources. It is entrepreneurs who allocate resources. They are influenced by prices along with other considerations.

Free Market Prices Contribute to Efficient Allocation

So much for a brief review of the scope and complexity of the relationships between free market prices and the allocation of resources within agriculture. It is clear that prices of both agricultural and nonagricultural products may be expected to influence the allocation of resources within agriculture. But how satisfactory are free market prices in contributing to an efficient allocation of resources?

One view is that the fluctuations of free market prices make them an unsatisfactory guide for the allocation of resources. Shepherd summarizes the argument as follows: "The problem [of controlling agricultural prices and production] arises because of erratic fluctuations in crop production . . . and because of the fluctuations in the demand. . . . The

resulting fluctuations in prices are a major disturbing force in agriculture."[1]

But are price fluctuations a major disturbing force? Of course some people are disturbed by price fluctuations. Sellers or prospective sellers are disturbed when prices fluctuate downward. Buyers are disturbed when prices go up. But by and large are price fluctuations primarily a disturbing or a stabilizing force in our economy?

The argument that price fluctuations generally are a major disturbing force in agriculture seems about on a par with saying that the wavering back and forth of the variable contact point on my furnace thermostat is a disturbing force in my heating system. True, if I fastened the points either together or apart there would not be so many reversals in the direction of temperature change, but that would not result in stabilizing the house temperature. Rather it would result in making the temperature less stable and, what is worse, either much too high or much too low. The fixing of prices of all agricultural products at unchanging levels, no matter what those levels were, would not stabilize agricultural production. Instead, it would interfere with a mechanism which tends to adjust agriculture to the conditions, including the changes, of its environment.

Under a system of competitive private enterprise, prices have a function and so do price *fluctuations*. It is quite as necessary that prices fluctuate as that they exist in order to guide the economy in its adjustment to changes in the weather, changes in production techniques, changes in consumer preferences, and so on.

Let us consider feed and livestock relationships. How much of our agricultural resources should be devoted to the production of cereals, fruits, and vegetables for direct human consumption? How much should be devoted to the production of livestock and livestock products? A thoroughly competitive economy of private enterprise would tend to work out an equilibrium solution which would maximize human satisfactions. There are, of course, limitations and qualifications to this.[2] For the present, however, I am interested in the variations from a normal equilibrium rather than in the qualifications of the doctrine as to the equilibrium itself. Suppose we have a short corn crop, should changes be made in order to attain maximum satisfaction? Suppose again that we have a bumper corn crop, should there be changes from the equilibrium situation in order to maximize satisfaction? Should livestock production be stabilized so as to remain unchanged and all the variation in crop output be absorbed by changing stocks of corn—or perhaps in years of

[1] Geoffrey S. Shepherd, *Agricultural Price Policy*, Ames, 1947, pages 11-12.
[2] See, for example, Professor Cochrane's article in *This Journal*, February, 1953.

bumper crops by wastage or other destruction of a part of the crop?

Let us conceive of a highly simplified situation—a closed economy in a stationary state corresponding to Marshall's famous analogy to a virgin forest. Let us suppose further that there exists a regular weather cycle which causes wide fluctuations in the production of feed grains and forage—fluctuations which follow a perfectly regular pattern and hence are precisely predictable years in advance. Under such circumstances it would be altogether possible to iron out all fluctuations of livestock production through feed-storage programs. But would that be desirable? Would not human satisfactions be greater if a part of the resources required for complete stabilization of livestock production through a feed-storage program were devoted to other production? Would it not be better to have some storage of livestock products and for people to eat more meat and other livestock products in the years of large agricultural production and less in the years of small production?

In the "spotted actuality" we have no such perfect knowledge of the output of feed crops for future years. There consequently can be no perfect planning for the use of feed and other resources for the production of livestock and livestock products, whether that planning is by private enterprisers or by government officials. Under such circumstances neither a free price system nor a controlled price system can justly be indicted merely because it fails to result in a perfect allocation of resources. The pertinent question is whether, in the light of imperfect knowledge and other inherent limitations in our situation, free prices or controlled prices would result in a better allocation of resources.

In the feed-livestock economy, the most important price control which has been exercised over the past 20 years has been that over corn prices. We have had corn price supports by loan programs ever since the fall of 1933, and during and immediately following World War II we had price ceilings, too. Have corn price controls decreased the variability of corn prices? Have they decreased the variations of livestock output? When I started to prepare this paper I had no doubt that corn prices have been much more stable under the programs than they would have been without them. But when I came to look for evidence to substantiate that view I found that the readily available evidence indicated a smaller stabilizing influence than I had expected. A comparison of coefficients of variation of monthly corn prices in several five-year periods before and after the beginning of corn price supports indicates only a rather modest reduction in the variability of corn prices—and that only if we omit the years prior to 1938 in measuring the variability of prices during the period of controls. The pertinent comparisons are as follows:

TABLE 1.—COEFFICIENTS OF VARIATION OF MONTHLY PRICES OF NO. 3 YELLOW CORN AT CHICAGO AND OF U. S. ANNUAL CORN PRODUCTION, FOR SELECTED FIVE YEAR PERIODS

Period	Prices: In money of current cents purchasing power	Prices: In money of 1926 purchasing power[a]	Production (previous year)
		(Percent)	
1909–1913	15.2	15.0	6.7
1923–1927	18.6	18.4	8.8
1928–1932	37.8	26.9	8.5
Average prior to corn loans	23.9	20.1	8.0
1938–1942	19.3	11.3	2.8
1942–1945	12.9	10.8	5.9
1948–1952	19.2	17.6	13.5
Average since corn loans	17.1	13.2	7.4
1937–1941	33.3	28.5	18.1

[a] As measured by the B.L.S. all-commodity wholesale price index.

In choosing the three five-year periods prior to the corn loan programs, it was possible to avoid war influences—including wartime price controls. The years 1909-1913 were before World War I, and 1923-1927 and 1928-1932 were well after that war. Since the inauguration of the corn loan programs, however, there have not been even two five-year periods in which we have been free of war influences. Furthermore, the extreme droughts of 1934 and 1936 were responsible for wide variations in corn prices in those years and in the years immediately following them. At first I used the calendar years 1937 to 1941 for one period, but this showed a larger coefficient of variation for deflated corn prices than did any of the three "preloan" periods—due to the influence of the 1936 drought on 1937 corn prices. Consequently, I decided to use the years 1938 to 1942 in spite of the overlap of one year with the 1942-1945 period.

In the 1942-1945 period corn prices were, of course, influenced by price ceilings as well as by the corn loan programs. During this period prices of corn were unusually stable in spite of the war. Prices of corn during 1948-1952 were influenced by a minor war and, furthermore, the coefficient of variation of corn production for the years 1947 to 1951 is greater than for any of the three pre-corn-loan periods. Nevertheless, the coefficient of variation of prices for 1948-1952 is less than for two out of the three pre-loan periods.

In view of all these considerations, I believe it is clear that corn price controls—including both the corn loan programs and the price ceilings

of World War II—have substantially reduced the variability of corn prices. But has this reduction of price variability of corn tended to stabilize the livestock economy?

Corn Price Fluctuations and Livestock Production

Coefficients of variation of monthly livestock slaughter indicate that there has been a slightly greater variation in federally inspected slaughter of both hogs and cattle in the three five-year periods since the advent of the corn loan programs than in those prior to the loan programs. In the first three five-year periods the coefficient of variation of monthly hog slaughter averaged 22.5 percent whereas for the three five-year periods since the advent of the corn loan programs they averaged 27.4 percent. (See Table 2.) The corresponding three-period averages in the case of cattle slaughter were 12.3 and 12.8 percent, respectively. Corn price controls would be expected to have more influence on hog slaughter than on cattle slaughter since corn constitutes a much larger percentage of the feed for hogs than of that for cattle.

In place of using the total variation of monthly cattle and hog slaughter, it is helpful to separate them into their cyclical and noncyclical components. This may be done roughly by obtaining a centered 12-month moving average and by finding the percentage which the actual is of the moving average. The coefficients of variation of these two monthly series are shown for each of the five-year periods in Table 2. The percentages of 12-month moving averages include both seasonal and the short-run

TABLE 2. COEFFICIENTS OF VARIATION OF FEDERALLY INSPECTED LIVESTOCK SLAUGHTER FOR SELECTED PERIODS

	Hog slaughter			Cattle slaughter		
	Total	Centered 12-month moving average	Percent actual of centered 12-month moving average	Total	Centered 12-month moving average	Percent actual of centered 12-month moving average
			(Percent)			
Jan. 1909–Dec. 1913	22.1	9.2	19.3	15.9	4.6	15.2
Jan. 1923–Dec. 1927	23.5	10.9	20.4	11.8	3.8	11.1
Jan. 1928–Dec. 1932	22.0	3.8	21.6	9.2	3.8	9.0
Average 3 preloan periods	22.5	8.0	20.4	12.3	4.1	11.8
Jan. 1937–Dec. 1941	28.1	15.8	22.4	10.5	5.9	8.6
Jan. 1942–Dec. 1945	29.9	18.9	21.6	17.2	8.7	14.1
Jan. 1948–Dec. 1952	24.2	10.0	21.4	10.7	4.4	9.5
Average 3 postloan periods	27.4	14.9	21.8	12.8	6.3	10.7

irregular fluctuations and could be broken down into these two classifications for further analysis. However, we are primarily concerned here with the cyclical changes and these are represented by the moving averages, though they also include a small trend component. Before the advent of the corn loan programs the average coefficient of variation of the moving averages of hog slaughter was 8.0 percent, while for the three subsequent five-year periods the average is 14.9 percent. Corresponding averages of the coefficients of variation of the centered 12-month moving averages of cattle slaughter are 4.1 percent and 6.3 percent, respectively.

These comparisons, then, do not lend support to the idea that reducing corn price fluctuations will necessarily help stabilize livestock production. Rather, they suggest that the reduction of corn price fluctuations which we have had under the corn loan and wartime price control programs may have increased the fluctuations in livestock production. They do not *prove* that corn price controls have made livestock production less stable, but they should give pause to those who argue that stabilization of corn prices is necessary to provide greater stability of livestock production.

Although one of the primary functions of price fluctuations is to change the allocation of resources, it should not be assumed that all price fluctuations cause changes in the allocation of resources. It is obvious that the day-to-day or week-to-week changes in corn prices during the winter months cannot be reflected in corresponding fluctuations in the acreage planted to corn.[8] Even large year-to-year changes in corn prices have small influence upon corn acreage, and the extent of influence will depend upon how the price change is interpreted in the light of other existing conditions. A decline of prices due to unusually large yields of a given crop is not, and should not be, interpreted by farmers as having the same significance to their production plans as an equal decline due to a shift of demand from that product to competing commodities. If farmers were influenced only by current prices at the time of planting or breeding, then most agricultural products would, in accordance with the "cobweb theorem," be subject to an explosive cycle of production and prices. This is on the assumption that the demand for most agricultural products is less elastic than the supply. The fact that agricultural products are not subject to such explosive cycles should be ample warning to economists that similarly simple models of the relation of prices to the allocation of agricultural resources do not constitute an adequate guide to agricultural price policy.

[8] This, of course, does not necessarily mean that such price fluctuations have no influence on corn acreage. The uncertainty involved in fluctuating prices might, for example, be one of the elements determining the long-run cost curve.

Effects of Price Changes Depend on Circumstances

Generally speaking, under a system of competitive private enterprise, a 25 percent decline of corn prices due to a bumper crop will have very little influence on corn acreage. It will, however, have a marked effect on the amount of corn carried over from that crop and upon the number of sows bred to farrow in the following spring. On the other hand, a 25 percent decline in corn prices due to a general decline of demand, while having little influence on acreage, will likewise have little influence either upon the carryover of corn or the breeding of sows. If, however, we were to have a 25 percent decline in the price of corn due to a decline in the demand for meats and dairy products relative to the demand for cereals, fruits and vegetables, it would result in a marked reduction in corn acreage, in carryovers, and in the feeding of hogs.

The foregoing is, of course, just another way of saying that in considering the effects of any given price change we must also consider the effect of other related price changes and that we must consider the dynamic effects of price changes.

The argument that price *changes* have an important function in a system of competitive private enterprise should not be taken to mean that all "free" price changes are to the good as far as the allocation of agricultural resources is concerned. As has already been noted, the price of a particular commodity has other functions to perform besides helping to allocate resources to the production of that commodity, and some of the fluctuations which are important to the allocation of the commodity to various uses may have little bearing upon the allocation of resources to the production of that commodity. But it should not even be assumed that all price fluctuations which occur in a competitive private enterprise economy are desirable for one purpose if not for another. We could expect such perfection of price change only under conditions of perfect "atomistic" competition and perfect knowledge both of the present and of the future.

Perhaps it will be helpful to attempt some sort of classification of price changes from the standpoint of their contribution to, or interference with, the optimum allocation of agricultural resources. One method of classification might be based upon the length of the fluctuation. As has already been indicated, the short-run fluctuations, generally speaking, may be expected to have little influence on the allocation of resources in agricultural production, whereas changes which are continued over a long period will have a much greater influence. But no rule can be laid down which will apply universally as to the length of time a price change must be continued in order to affect the allocation of resources. An increase in hog prices may affect feeding rates even though it is not

continued for long, but farmers may not decide to increase the number of sows bred unless the price rise is continued for a longer period of time. The price of oranges might have to be increased over a much longer period to affect significantly the plantings of orange trees. Then, too, the time of year at which a price change takes place may be significant in determining how long it must continue in order to have a material influence on the allocation of resources which affect the production of a commodity.

Without in any way minimizing the importance of the time element in determining the response of resource allocation to price changes, I should like to suggest another basis of classification of price changes: (1) changes due to monetary inflation and deflation; (2) changes due to increases or decreases in the general level of "real" demand; (3) changes in the relationships between prices of agricultural products which do not involve either of the first two classifications.

Price changes of the last sort are the ones which are most effective—and beneficially effective—in changing the allocation of agricultural resources. When there is a rise in the price of one agricultural product without any change in the prices of other agricultural products or in the prices of nonagricultural commodities, this constitutes a powerful incentive to increase the allocation of resources to the production of that commodity, especially if the rise in price is continued over a considerable period of time and appears to be due to relatively permanent causes. Such price changes, if they arise out of a free market situation, are usually highly effective in contributing to better utilization of agricultural resources.

When there is a change in the general level of demand it is usually due to a change in the output of nonagricultural commodities and involves a general rise or fall in the level of agricultural product prices relative to those of other industries. Under these conditions, however, some agricultural products may be expected to rise or fall more than others. Under these circumstances prices appear to provide a less satisfactory guide to the allocation of resources within agriculture than in the case first discussed, but the extent to which this is true depends largely upon the rapidity of the rise or fall in the general level of demand. Also, the allocation of agricultural resources seems to work out more efficiently during a rise in the level of demand than when it is falling. Furthermore, a decline in the real demand for goods is, under modern conditions, almost sure to involve a monetary deflation.

It should also be pointed out that cyclical changes in the general level of demand for farm products may well be due to the lack of free prices in some sectors of the economy. Whether existing technical and institu-

tional conditions make thoroughly free prices impossible is another point. If depressions and under-utilization of resources are impossible under thoroughly free prices, then the failure of prices to provide satisfactory guides to the allocation of agricultural resources during business cycle fluctuations cannot be justly charged to the inadequacies of free market prices but rather to the fact that prices are not free. To me this particular point seems relatively unimportant for our present purposes. Rather, it is important that free market prices for agricultural products have certain limitations as guides for the allocation of agricultural resources when there are large fluctuations of output and employment in the nonagricultural industries.

Market prices are especially likely to be misleading guides to the allocation of resources when they are under the influence of rapid monetary inflation or deflation. Whether because of government controls, private "administrative pricing," the inertia of individual habits, or something else, some prices change much less readily than others. During a period of monetary inflation the resistance of some prices to change increases the volatility of the flexible prices. During the past decade the slowness of rents, freight rates, and distribution costs generally to rise resulted in a more rapid rise in the prices received by farmers for farm products than there would otherwise have been. For most consumer goods, the primary effect of monetary inflation is upon retail prices. Wholesale prices and prices received by farmers are equal to the retail prices minus the distribution charges between them and the retail prices. Thus in a period of monetary inflation, a lag of distribution charges behind the rise of retail prices results in a temporary rise of wholesale prices and farm product prices which is more than is warranted in the long run by the existing amount of the inflation. When wholesale prices started down early in 1951 it was not because inflation was over. Instead, the trend of consumer prices is apparently still upward. The money supply was clearly increasing much more rapidly than the volume of trade through 1952. But the burst of "speculative" inflation ended early in 1951 and after that distribution charges were "catching up" with inflation.

This is not to say that the first effect of inflation is usually on retail prices, neither is it implied that if one wants to forecast wholesale farm prices he should do it *via* retail prices. Quite the contrary. Inflationary tendencies are usually first felt in the wholesale markets—especially those for speculative commodities. In case of commodities entering international trade the turning points of their price movements may be dominated by foreign rather than domestic conditions.

But this takes us aside from the main point. The point is that because of varying degrees of flexibility and rigidity in different parts of the price

structure, inflation and deflation tend to throw the price structure out of balance and to make price relationships misleading guides to the allocation of resources. Some price dislocations continue for a period of several years. Though market prices may be freely determined within agriculture or within any other sector of the economy, that does not make that sector free from the disturbing influence of an unbalanced rise or fall of prices.

DISCUSSION

WILLARD W. COCHRANE
University of Minnesota

Professor Working has suggested that the title of his paper may have been selected to start an argument. I suspect that he is right. Thus I shall try to measure up to my responsibility by taking issue with some of the ideas in his paper.

Most of us would agree with Working when he says "Changes in the relationships between prices of agricultural products . . . are the ones which are most effective—beneficially effective—in changing the allocation of resources." This is what economists expect of relative price changes, and this is what we see occurring in most areas of agriculture. Further, most of us would agree with the statement "that: because of varying degrees of flexibility and rigidity in different parts of the price structure, inflation and deflation tend to throw the price structure out of balance and to make price relationships misleading guides to the allocation of resources." As an aside, but in this connection I do take exception to the idea expressed as follows: "if depression and under-utilization of resources are impossible under thoroughly free prices. . . ." I thought even Pigou had given up this position.

But agreement on the above conclusions does not answer the implied question of this paper—How effective are free market prices in allocating resources within agriculture? Are there more effective means of allocating resources? Are free market prices 100 per cent effective or 50 per cent effective or what? These are the fundamental and implied questions of this paper, and to my judgment they are not answered. What I miss here is: (1) the development of a systematic framework in which to consider the point at issue; and (2) the formulation and use of a formal standard against which to appraise the performance of free market prices. Perhaps the implied standard is that of a perfectly competitive market, but if so, the analysis is not developed in such a way as to make use of that norm. In short, Professor Working loses me, and he loses me for the reason that no set of standards is provided against which to check or appraise the points made in his paper. Now let me hasten to add that I am glad that it did not fall my lot to prepare this paper, for I do not have a ready made framework and set of standards for dealing with the subject. In fact, I am not sure that such a broad topic as *The Effectiveness of Free Market Prices in Allocating Resources* can be successfully dealt with in one short paper. Scitovsky found it necessary to write his recent book, "Welfare and Competition," to cover the subject and perhaps that is where we should turn for some general answers.

A major part of this paper is devoted to an analysis of the relation of corn price variability to meat production variability. Some interesting data are pre-

sented, and the idea is suggested that the decrease in corn price variability resulting from government programs contributed to hog and cattle slaughter variability. But what is the meaning, or the significance, of this relationship for the subject under consideration? In the first place, the suggested relationship between corn price variability and meat production variability is consistent with firm theory; hold the cost structure of the firm constant in any diagram and let the price line vary (as was the case with cattle and hog prices) and see what happens to output. In other words, we would expect meat animal production to vary more, where animal prices fluctuate relative to corn prices, than where both move up and down together. So we agree that the imposition of a price rigidity in an otherwise system of free markets leads to allocative difficulties.

But is this a fair presentation? Is not the real question the following: Which gives the better allocation of resources (1) a situation where all input and product prices are free or (2) a situation where all product prices and input prices have been stabilized in a consistent manner? I don't have the answer to that question, but I would expect that the answer turns on the structure of free markets under consideration (e.g., purely competitive, oligopsony confronting many sellers, bilateral monopoly, etc.) and the nature of the mechanics employed to stabilize prices. And that the answer will be forthcoming only where a free market of some structure and a controlled market of some structure are compared and tested in term of some standard of performance.

Throughout his paper Professor Working uses the terms price change and price fluctuations interchangeably and this, I believe, leads to trouble. Generally we do not use the words *fluctuation* and *change* as synonyms; by *change* we mean a movement from one position to another, by *fluctuation* we have in mind oscillations through time. Thus, price may be said to change when it moves from $1.00 to 80 cents, but it fluctuates when it moves from $1.00 to 60 cents to $1.10 and then back to 80 cents. Now where prices fluctuate because of over-adjustments in demand or supply or both, I would argue that free market prices are not doing a good job—are ineffective to some degree. And I would argue this point at two levels.

First, where a commodity is produced and sold under widely oscillating prices, consumers will in certain cases pay more for the product than with stable prices. A pure case may be developed as follows: assume a commodity with constant demand and supply elasticities of .26 (any inelastic value would, of course, do); this results in a continuous cobweb pattern. Assume further, that output adjustments result exclusively from changes in acreages. Now given a starting price of 50 cents, price will gyrate endlessly between 50 cents and $5.00 around an equilibrium price of $1.00. In this illustration the average price with fluctuations is $1.29 and the average price with stability is $1.00. In other words, the consumer pays 29 cents more per unit where prices fluctuate than where they are stable at the equilibrium level. And in light of Working's pointed jab at practitioners of the "cobweb theorem," it seems appropriate to point out that pure cases are not likely to exist in the real world, but insofar as real cases tend in the direction of this example price fluctuations may be said to create inefficiencies.

Second, and more important in my view, price fluctuations create uncertainties in the minds of producers and thus interfere with long-run production planning. I take it to be the case that the greater the price fluctuations, the greater the uncertainty, and the more reluctant the farmer is to make the additional cash outlays associated with increased capital inputs or the adoption of new

technologies. The more stable the prices, assuming they are high enough to hold the farmer in production, the more sure he is of the future and the more willing he is to make the cash outlays associated with new techniques. Thus given the technologies and the average level of prices, I would expect to find the rate of technological advance more rapid with stable prices than variable prices. Further, I am inclined to guess that the efficiency implications to the economy of variable rates of technological advance are of greater importance than the static problem of variable proportions.

But the question arises—What evidence is there to support the above statements? I would offer two types. The first consists of an appeal to personal experience. I know that I would be more inclined to borrow funds and sink my savings in improved techniques to expand production where I was certain of the future, than where I wasn't (assuming, of course, that the certain future is a happy one). Second, in the work we have been doing at Minnesota concerned with the impact of government programs on the potato industry we have observed the following: (1) the deflated price of potatoes averaged almost the same in the two periods 1934-41 and 1942-50, but (2) production jumped from an average of 369 million bushels per year in the first period to an average of 430 million bushels in the second. And this increase in output cannot be explained in terms of increased inputs of land and labor; both decreased in the second period.

We think it is to be explained in terms of increased specialization involving increased capital inputs and new methods. And this in turn was induced by a reduction in year-to-year price fluctuation from 39 per cent in the first period to 11 per cent in the second. In short, we say that the important supply response in potatoes during the support period 1942-50 cannot be explained in terms of a relative price change, but it can be explained in terms of the elimination of price risk which resulted from the price stability provided by price supports.

DISCUSSION

RAINER SCHICKELE
North Dakota Agricultural College

The comments that stimulated me most appear in the first few pages of Dr. Working's paper. He suggests that "free market prices" should mean prices that are free of government or private controls and free to change. He points out that "agricultural prices are almost universally both free to change and free of controls" except for the few government price support programs, "while many non-agricultural prices are not free." Since agriculture in the U.S. is highly commercialized and integrated in the general economy, he concludes that although agricultural prices are "free," it can hardly be said that the values of agricultural products are established under free market conditions, and that "the question of what the allocation of agricultural resources would be under conditions of thoroughly free prices is largely hypothetical."

From then on, he does what most of us usually do: he forgets about these most crucial facts of economic life and interests himself in "the variations from a normal equilibrium rather than in the qualifications of the doctrine as to the equilibrium itself." I shall try now to interest you in the qualifications of the free competitive equilibrium doctrine.

Let me start out by raising a simple and obvious question. If free prices do the best job of allocating resources, should we not infer that resources are better allocated in agriculture than in industry? But per capita income is typically lower in agriculture than in industry. What better gauge do we have for the goodness of resource allocation than the well-being of people? If people fare better under partially administered or regulated prices than under free prices, is it not proper scientific procedure to infer, at least tentatively, that regulated prices may result in better resource allocation than free prices?

There is, of course, the classical argument that if there were free prices in industry also, everyone would fare better in the long run, in industry and agriculture, and farm people relatively more so as the free market forces would equalize levels of living between the two sectors. But would they, except by definition under our competitive equilibrium doctrine?

I submit that this argument lacks empirical verification. What relevant observations there are suggest that facts do not verify the sweeping generalizations of the competitive equilibrium hypothesis. In the first place, the basic assumptions underlying the free market doctrine never hold for a total economy; in the second place, where they hold approximately for a partial sector of an economy, such as for U. S. agriculture or unorganized labor, resources are not so allocated as to give its people better living levels than the people in other sectors receive. The least we can conclude is—and I am cautious in the good scientific tradition—that the wide range of price regulation and other administered allocative non-price devices used in the industrial sector has not resulted in a degree of misallocation of resources that has made people worse off than in agriculture with its free market price system. I believe that I remain on good scientific ground as I carry the argument a step further and suggest that price regulation and other non-free market devices in agriculture *could*, if properly conceived and administered, improve farmers' well-being and resource allocation.

I invite you to explore with me two aspects of economic activity, the implications of which call for a re-examination of the usefulness of our classical equilibrium doctrine and of the free market price norm.

Socio-political Organization and Market Power

Our concept of a free market price system disregards the factual necessity of group action of socio-political organization, both of which are as basic to economic activity and development as are the quantitative aspects of resources, production and consumption. Markets function, and prices are determined, always within a framework of institutions, of group organization, of political structure, and of market power relations between buyers and sellers. All these factors are subject to human volition, to group control, and to deliberate change. They can only be taken as given in the very short run, and even then do they vary a good deal from the basic assumptions underlying the equilibrium doctrine of a free competitive market.

In the context of a dynamic society, the concept of the free market represents an inherently unstable situation. If an economy were to start from a state of truly atomistic free competition within the framework of an anarchistic utopia, it would take less than a generation for economic and political power centers to develop. This, in turn, would restrict the free automatic play of self-equilibrating market forces and reduce the area of atomistic free competition to fields of activities where the *social results* of such free competitive forces appear acceptable to society, or where people have so weak an economic bargaining

position and are politically so inarticulate that they have no choice in the matter. This, I suggest, explains the essential features of the market systems in most contemporary societies, including our own.

Hence, the belief that the resource allocation resulting from free market prices is the best for society implies a moral commitment to anarchism as a political organization, and to a widely dispersed distribution of all productive property under owner-operatorship as an economic organization—a commitment to two basic values which probably none of us here hold in any realistic sense.

Markets, of course, do function everywhere, and prices do influence the allocation of resources as well as of consumption and income, under whatever institutional framework of economic and political organization people go about earning a living in any particular society at any given time. Only, such markets are never free in the classical economic theory sense. Nor is there any justification for accepting the hypothetical results of such a non-existent market as a *norm* for what ought to be, for judging the goodness or badness of resource or consumption or income allocation.

I suggest that a much more appropriate norm is a well-defined concept of equitability of income distribution in terms of comparative living levels of various parts of the population. If income distribution is found inequitable, as for instance in agriculture, public policy can use price regulation and various other allocative devices to redirect resources in such a way as to improve the income position of the disadvantaged group. This would appear particularly appropriate if the disadvantage of the group results from a weak bargaining position in the market of factors and products, from lack of access to needed resources, and from extreme risks and uncertainties.

We should not let ourselves get hypnotized by the influence of prices upon resource allocation alone. Prices influence the allocation of consumption goods and the distribution of income among people just as much and probably even more than resource allocation. Moreover, as Professor Working has said so forcefully: ". . . prices do not allocate resources. It is entrepreneurs who allocate resources." And entrepreneurs are not only individual persons, but cooperatives, corporations and the government and its various subdivisions as well. This means that the influence of prices upon resource allocation is anything but direct. We economists tend to give a misleadingly heavy weight to prices as determinants of resource allocation. We would do well to examine much more rigorously than we have done so far the non-price determinants of resource allocation on the one hand, and the influence of prices on consumption allocation and income distribution on the other.

Price Fluctuations and Resource Allocations

I am aware that these considerations produce a feeling of frustration or impatience in many of my colleagues. I don't feel very comfortable with them myself. The competitive equilibrium doctrine is a boon to an economist's peace of mind. Unfortunately, these institutional and socio-political power considerations are not the only ones that are shaking our faith in the free market system. Indeed, even if we cling to that faith in an amorphic society without power centers and socio-political stratification, the effectiveness of free market prices in allocating resources leaves much to be desired. In an empirical sense, it is not even conceptually sound, because it presupposes perfect knowledge of past, present and future on the part of entrepreneurs, perfect divisibility and mobility of factors, and the individual's income maximization as the sole motivation

of economic activity. We know perfectly well that these assumptions don't apply, even in a proximate sense, to most real situations.

There are many types of price fluctuations which cannot influence entrepreneurs to shift resources, because their cycle is shorter than a production period, or because the entrepreneur has no alternative opportunities for shifting resources, or because the fluctuations are so unpredictable that they do not affect his price expectations upon which he acts. There are other types of price fluctuations which, if they could influence resource allocation, would influence it in the wrong direction. It is clear, that regulating prices so as to reduce or eliminate these types of price fluctuations would *not* impair resource allocation, but could actually improve it by giving the entrepreneur a greater certainty of price expectation upon which to plan his production process.

Regulated prices do not mean prices fixed for time eternal. They mean that prices are changed for sufficient cause and for specific purposes. The main issue is whether the *result* of regulated prices from the viewpoint of people's welfare can be made better than the result of free market prices. That depends on who does the regulating, for what purpose, and how effectively. This issue, then, is no longer one of economic doctrine concerning the ultimate goodness of a self-equilibrating automatic market system, but is one of experimentation and testing the results of various pricing systems in various sectors of the economy, with respect to the well-being of the people affected. It means that people should be left free to find out under what conditions and for what commodities certain types of price regulations work better than others, and under what conditions and for what commodities free market prices work better, within the framework of existing institutions, practices and distribution of bargaining power and income. The criteria of what constitutes "better" or "worse" consequences of alternative market systems ultimately rests in group value judgments, articulated by socio-political processes, and not in the axiomatic premises of an economic doctrine.

In the present juncture of our socio-economic development, we may be in danger of losing one of the prime characteristics in the American tradition: the lack of dogmatism concerning economic policy. Our economic history grew out of a pragmatic philosophy and an experimental approach: we did whatever we thought would do the job best. If individuals and private business could do it, fine; if not, we made our government help individuals or private groups to do it or charged the government with doing it directly, and kept a close eye on the performance. In this way, we avoided much of the sharp class conflicts, and utilized vast human talents, physical resources and organizational techniques that remained untapped under the more doctrinaire and less pragmatic policies which have characterized European economic development.

I hope we will continue to approach problems with an open mind, and tackle them in whatever ways we know best so as to meet the legitimate needs of people, especially of those people who are vulnerable to economic forces beyond their control. Improved allocation of resources in agriculture is one of these ways, and where free market prices do not bring about such needed improvements, or even impede it, appropriate price controls along with other suitable devices should be considered according to their merits and effectiveness rather than whether they fit into any particular doctrine.

FARM PRICE SUPPORTS

Chairman: A. H. Harrington, State College of Washington

THE FEASIBILITY OF PRICE SUPPORTS FOR PERISHABLE FARM PRODUCTS*

GEOFFREY SHEPHERD**
Iowa State College

PRICE supports for perishable farm products are one of the most important and difficult problems in the field of agricultural price policy. The scale of price-support operations for perishable farm products in the United States since 1935 is shown in summary form in Table 1, along with data for storable products for comparison.

The upper part of the table shows that price-support programs up to the end of 1952 cost the Federal government one and three quarters billion dollars. This is more than twice as much as the cost of price supports for storable (durable) products shown in the lower part of the table. It is a lot of money. The subject surely deserves our attention on that score alone.

Table 1 classifies operations under two heads: "Expenditures on Section 32 programs" and "CCC losses on price-support operations." Study of the operations conducted under these two heads should show whether price supports for perishable products have been feasible in the past, and provide a factual basis for recommendations concerning price supports for perishable products in the future.

Accordingly, this paper is divided into two parts. In the first part, we examine the record to see how the price-support programs for perishable products have worked out in the past. In the second part, we go on to make some modest recommendations for the future.

The Record of Price Supports for Perishable Products

1. "Section 32" operations to increase the demand for specific products by government purchase and free distribution, diversion to lower uses, or export.

Section 32 of the Act of August 24, 1935, Public Law 320 (74th Congress) gave the Secretary of Agriculture the authority and the funds to widen the outlets or increase the demand for surplus farm products (a) by encouraging exports, (b) by encouraging domestic consumption,

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** I am indebted to J. Murray Thompson, PMA, for data and pointers on Section 32 and CCC operations, and to Don Kaldor and Fred Waugh for other comments.

and (c) by making direct payments to farmers. The funds provided annually were an amount equal to 30 percent of the funds collected by the Treasury from duties on imports.

TABLE 1. EXPENDITURES ON SECTION 32 PURCHASE, DIVERSION, AND EXPORT PROGRAMS, AND COMMODITY CREDIT CORPORATION LOSSES ON PRICE-SUPPORT OPERATIONS FOR PERISHABLE PRODUCTS

(Millions of dollars)

	Fiscal years 1936–41	July 1941 to December, 1949	Jan. 1, 1950, to December 31, 1952	Total
Perishable products:				
Sec. 32 expenditure	301	502[a]	143	945[a]
CCC losses	—	402	414	816
Subtotals	301	904	557	1,761
Storable products:				
Sec. 32 expenditure	254	180	23	456
CCC losses	60	6	182	249
Subtotals	314	186	205	705
Totals	615	1,090	762	2,466

[a] Includes $138 million in cash payments made to the school lunch program from Sec. 32 funds prior to Public Law 396, 79th Congress, approved June 4, 1946, the National School Lunch Act.

Table adapted from: *Price Supports for Perishable Products: A Review of Experience*, Senate Committee Print, October 17, 1951, p. 1, and correspondence with PMA.

Since 1936, section 32 funds have been used to increase the demand for about 90 different farm products. Expenditures on perishable products rose to a peak of $129 million in 1942, declined to $8 million in 1946, and have ranged between $37 million and $66 million since that time. The total amount of Section 32 funds available annually has ranged from $160 million in 1950-51 to $400 million in 1952-53 (the latter figure including carryover balances from previous years).[1]

Section 32 activities are generally limited to "surplus removal" operations. Most of these operations have involved purchases of limited quantities of surplus commodities to raise producer prices and increase consumption by needy persons. The objective is not to raise the price for the whole crop up to a given level, but merely to relieve a surplus situation and support prices to some extent. The products purchased are disposed of currently. The School Lunch Program has been the principal outlet in recent years for the products purchased under this type of program.

[1] Section 32 Handbook, March, 1953, PMA, USDA, p. 18.

Section 32 programs have a good score on the use of the products that were purchased under the programs. The products that were in surplus supply were not always the ones that were most needed nutritionally, but at least most of them were consumed as food, and only relatively small quantities were diverted to non-food uses. About 51.4 percent of the Section 32 expenditures since 1935 were devoted to the free distribution of food to the School Lunch Program and direct to needy families, and 19.6 percent went for the Food Stamp Plan. Only 17.9 percent of the expenditures were made on products that were exported, and 7.2 percent for those that were diverted to lower uses.[2]

The price-supporting potential of Section 32 programs is low. Only a small percentage of the crop can be disposed of in non-commercial channels. "The limited extent to which Section 32 programs can provide outlets for surpluses is indicated by the fact that nonprofit school lunch programs and charitable institutions, the major outlet for surplus agricultural commodities, cannot utilize more than 1 to 3 percent of the total production of most agricultural commodities."[3]

In most cases, therefore, Section 32 programs have involved the purchase of only small percentages of the crop and have supported prices only to a small extent.

2. CCC operations to support prices by government purchase for temporary withdrawal from the market when it is weak and later returned to the market when it is strong, or for diversion to lower uses.

These are usually large-scale operations designed to support the price of the whole crop at a given percentage of parity. Under Section 32 purchase programs, acquisitions are limited to those quantities for which immediate outlets are available; but under CCC price support operations, commodities are acquired to the extent needed to fulfill the price commitment regardless of whether an outlet exists.

It is these operations that have caused the rise in expenditures on perishable products in recent years, as shown in the second line of Table 1. The storage life of these products is short, in most cases less than a year. Unless a fortuitous rise in prices takes place during that period, the commodity has to be sold in some specialized foreign or domestic market at reduced prices, or diverted to lower uses, or under certain limitead conditions, given away.

The record of the CCC programs on the score of the use made of the farm products that were purchased under the programs is not good. About 85 per cent of the CCC losses of $402 million on perishable prod-

[2] Ibid., p. 29.
[3] Ibid.

ucts during the period from July 1, 1941, to December 31, 1949, resulted from the price-support programs for Irish potatoes. Losses on egg price supports amounted to about 10 per cent of the total losses for all products, leaving only 5 per cent of the total to be accounted for by all other products.

The heavy losses on potatoes resulted from the fact that large quantities of potatoes acquired by the CCC were diverted to non-food uses of such a low order that the diversion was tantamount to destruction. The CCC purchased and diverted 29 per cent of the 1948 potato crop, at a cost of 224 million dollars. Two years later, 43 per cent of the CCC purchases of the 1950 potato crop was used for livestock feed (in some cases sold for that purpose at 1 cent per 100 pounds) and 32 per cent was in fact deliberately destroyed on the farm where it was produced.[4] The potato price supports were reduced from 90 to 60 per cent of parity in 1949, and the potato price program was abandoned entirely in 1950.

The thing that aroused public resentment against the potato program was the actual or virtual destruction of a substantial part of the crop after land, labor, capital and entrepreneurship had been spent on its production. Programs that lead to large-scale destruction like this evidently are not feasible.

The record for dairy products in 1949-51 is better, though for fortuitous reasons. More than half of the dairy products purchased were used for food in the United States. This was chiefly due to the unexpected strengthening of the demand that resulted from the outbreak of war in Korea in 1950.

The current CCC operations with butter are similar to the 1949-51 operations, in that most of the butter is being used for food purposes, not diverted to lower uses or destroyed as the potatoes were. Thus the consumption of the product as food is not reduced. In this respect the record is better than the record of the potato program.

But both programs were or are anti-social on two other scores. They induce the production of more of the price-supported products than consumers demand at the supported prices, and at the same time reduce the quantity that consumers will demand at the supported price. The surplus products are diverted to lower uses, or destroyed. This misallocation of productive resources and diversion or destruction of consumer goods reduces total welfare. In addition, the program buys at one price (about 66 cents a pound as a national average for butter this year, for example) and sells at a much lower price (15 cents a pound for about 15 million pounds of butter to the United States Army). This adds to the tax

[4] *Price Supports for Perishable Products: A Review of Experience,* Senate Committee Print, October 17, 1951, pp. 13-14, 19.

load, and the proceeds of the tax are used to subsidize one product at the expense of others, for no clearly valid economic reason. This feature is quite unpopular.

The overall conclusions from study of the record are two:

1. Section 32 programs are feasible, but they are limited to small percentages of a crop and can have only a small effect on prices.

2. CCC price-support programs such as the potato and butter programs, which do have a substantial effect on prices, are likely to be short-lived; they are not feasible once a few years of experience has demonstrated their uneconomic nature.

Are there any kinds of price-support programs both effective and feasible, and desirable from an economic point of view?

Recommendations for Future Programs

It seems to me that effective, feasible and economic price support programs for perishable farm products can be developed, by action along several lines.

1. *An expanded program of research and extension in agricultural price policy to develop more agreement on the economic objectives of price support operations.*

It is becoming clear that the objective of price supports cannot be to raise prices above long-run free-market levels. The general public will not stand for the large scale diversion or destruction that is required to carry such programs through. That sort of program is not feasible.

At the opposite extreme, farmers will not accept price supports which merely "provide insurance against disaster" in Secretary Benson's phrase last winter. That sort of program is not feasible either.

A third objective, between these two extremes, is feasible. This objective is to stabilize prices about long-run free-market levels, without attempting to raise those levels. This stabilization serves to reduce erratic short-time variations in prices that confuse, rather than guide, farmers in laying their production plans. It therefore improves the allocation of resources, and thus increases national welfare. In addition, the reduction of uncertainty releases one of the brakes on production, and the increased production benefits the nation all around.

Movement in this direction would be facilitated if we would stop talking about price supports and speak instead of price stabilization. We should expand our research and extension in the field of agricultural price policy, to develop more agreement on feasible objectives of price policy and how they may be attained.

2. *Changing the parity price index to a parity cost index.*

More general agreement is also required as to what "the long-run free-market level" means.

It means the average level of recent years, adjusted for the effects of current and prospective technological and other changes in demand and supply.

It does not mean 90 per cent or any other fixed percentage of parity as now defined. Even modernized parity, based on the most recent 10 year moving average, is too inaccurate and too far behind the times for this purpose. The use of the same parity index (index of prices paid) for all crops is as invalid as the use of the same index of prices received would be for all crops.[5] Where the per unit cost of producing a given crop has been greatly reduced (or increased) the parity index for that crop should be reduced (or increased) accordingly. This would be done automatically if a separate parity index, not of prices but of *costs* per unit—that is, $\frac{\text{prices x quantities purchased}}{\text{quantities produced}}$—were computed for each crop. If this had been done for potatoes, parity prices for potatoes would have been substantially lower, in line with the lower per unit costs, the price support operations for potatoes would have been comparatively small, and a workable potato price support program could have been continuously maintained.

3. *Changing the level of price supports in line with changes in demand.*

The computation of separate parity indexes of costs would be a step in the right direction. A further step would be required, however, to avoid the difficulties that we are having now with butter price supports. For those difficulties result, not from a reduction in costs, but from a long-run reduction in demand.

This reduction in demand has been in progress for a long time. It was clearly revealed and measured by research published in bulletin form several years ago, and its continuation in the future was clearly implied. This kind of change in demand is not reflected in the present parity formula until several years have passed. Two kinds of action are required to deal with it: (1) Further development of long-range "Outlook" work, to show more clearly what is coming over the next several years, and (2) the lowering or raising of price support levels as soon as the change in demand becomes clearly evident, so as to provide more concrete incentive for producers to begin to change their plans.

[5] This point is developed more fully in my article, "What Should Go Into the Parity Formula?" *This Journal* XXXV:2, May, 1953.

This situation is a challenge to us as research men, teachers, and extension men in the field of price policy. The United States' half billion dollar loss on an uneconomic potato price-support program illustrates what is bound to happen to programs of that nature. But we have let the United States waste several hundred million dollars more on an uneconomic butter price-support program. If we could have managed to mount a 10 million dollar research and extension program in agricultural price policy, it could have saved the country 10 or 20 times its cost. Action along these lines is urgently needed.

4. *An expanded program of feed grain storage operations to stabilize the flow of feed grain supplies to market and thus stabilize livestock production and prices.*

This type of program is preventive medicine. Its objective would be to reduce variations in livestock prices by reducing one of their chief causes—variations in livestock production.

These variations in livestock production can be reduced by a storage and unstorage program for feed grains that stabilizes the market supplies and prices of feed grains. This stabilization of livestock production tends to stabilize livestock prices, insulating them against the effects of year-to-year variations in the production of feed grains due to variations in the weather. This reduction in the variability of livestock prices reduces the size of the job of stabilizing them.

The CCC feed grain storage program that has partly stabilized the flow of feed grains to market over the past 20 years needs to be doubled in size in order to do the job. The CCC year-end carryover of corn (September inventory) has been small compared with the variations in production that they are designed to smooth out. The maximum size of these stocks, attained in 1951, was only 403 million bushels.[6] Stocks of a billion bushels or more are needed to do a reasonably good job of stabilizing supplies and prices.

This type of program, however, can be used only for livestock and other products that are dependent upon the supplies of a durable product like feed grain. Perishable crops like potatoes, that are consumed in their original form and are not the result of feeding some durable crop, constitute a price stabilization problem that cannot be shifted backwards to their raw materials. That problem requires solution by other means, suggested in the next section.

5. *Direct payments to farmers or processors to make up the difference between open-market prices and price support levels.*

A direct-payment program could support prices, not by purchases in

[6] CCC Charts, PMA, USDA, November, 1952, table 16.

the open market, but by (1) payments to processors which would enable them to pay prices at the support level to farmers, or (2) direct payments to farmers, which, added to their receipts from the sale of their products, would bring their total receipts up to the level they would reach if prices had been raised to the support level.

This type of program is usually only half endorsed by economists, because, it is said, it would solve only half of the price support program for perishables; it would avoid the reduction of consumption that results from high support price levels, and keep the products all moving into consumption, but it would not avoid the stimulation to production that results from high price levels.

This appraisal, I believe, is not valid when a program of direct payments is being used for the stabilization purposes outlined in earlier sections.

When prices are low only temporarily, as in the case of hogs a year and a half ago, the problem is not how to avoid increasing production, but how to keep producers from *reducing* production, temporarily, and thus causing a temporary shortage of hogs and high hog prices a year or two later, such as we have seen during 1953. A guarantee of say $20 per 100 pounds in 1951-52, implemented by direct payments, would not have stimulated over-production, because it would have been a little below long-run open-market price levels. But it would have avoided the temporary underproduction that caused a rapid rise in hog prices this year, which in turn will lead to over-production and low hog prices again in another year or two.

It seems that a direct-payment program for stabilization purposes would have desirable, not undesirable, economic effects on production as well as consumption. It would smooth out temporary variations in production and thus reduce the need for price supports when the goods come to market.

Some farm leaders believe that farmers do not want direct payments; they want returns from sales in the open market. The results of a survey of 588 farmers in Iowa and Illinois conducted in April, 1953, by C. C. Clifton and R. J. Jessen, do not support this view. They show three things. First, 59 per cent of the farmers believed that the United States Government should support cattle prices during a period of depression. The figure for hogs was also 59 per cent. Both of these figures were only a little lower than the figure for feed grain prices, 63 per cent. The percentages in favor of supporting prices at the time the survey was taken (a time of prosperity, even though cattle prices were a third lower than the year before) were considerably lower—36, 30, and 44. Second, of the 383 farmers who thought any one of the three prices should be supported, 75 per cent thought that livestock prices should be

supported if feed grain prices were supported; 73 per cent thought that the supports should be flexible, varying inversely with supply. And third, 28 per cent favored supporting livestock prices by means of direct payments—a much higher figure than for any of the four other methods listed.[7]

6. *Development of a new form of production and marketing agreement.*

Agricultural price programs are beginning to graduate from their early stage of holding a match to the thermometer without doing anything to cure the disease, to the next stage where the program starts with diagnosis of the disease, prescribes the appropriate remedy, and observes the temperature returning to normal as the patient returns to health.

This stage would be facilitated by the creation of a separate production and marketing committee for each important farm product, to report on the present and prospective status of each product from time to time. These committees would go considerably further than the advisory committees created under the RMA. When a product got into price difficulties, or appeared likely to get into them, the committee would report them to the Secretary of Agriculture. But instead of merely applying for price supports at some percentage of parity without doing anything to remedy the causes of the price difficulties (price supports alone merely perpetuate the causes instead of remedying them) the committee would bring in a plan to increase the demand, change the product, or reduce the production, or whatever was needed to correct the situation. Temporary price supports might play an incidental part in this plan, or they might not be used at all.

This system of committees would be set up in recognition of the need for different programs to fit different commodities. It would embody the principle of price support operation established in Canada with the creation of the Prices Support Board in 1944. The principle is made clear in the following excerpt:

"Price support action usually is initiated when representatives of an interested commodity group present their case before the Board. After the

[7] See also "Agricultural Policy: Whose Valuations?" by Dale E. Hathaway and Lawrence W. Witt, *This Journal*, August, 1952, p. 299. This reports the results of a survey of farmers' opinions which showed that (1) over half of the farmers said that they had never heard of direct payments before, yet (2) after considering direct payments, nearly as many of the farmers preferred them as preferred the existing diversion methods; the potato producers preferred direct payments nearly two to one. The Wallaces' Farmer polls over the past three years report that two-thirds of the middle western farmers interviewed favor price supports for hogs, and 37 per cent of that two-thirds prefer production payments, 48 per cent preferring buying and storing pork, plus some plan for distribution.

Board has studied the situation, it makes its recommendation to the Government that assistance be or not be given. If it favors assistance, it also will recommend the prescribed price and the amount of help plus a feasible method of support. If the Cabinet approves, then the support program is put into effect by the Board.

"While no historical price formula is used to compute a support level, when the Board draws up its support blueprint, it considers historical price patterns for the commodity concerned and price levels at which related commodities, if any, are being supported.

"The determination procedure also includes a study of three things: (1) the basic cause of the price or income decline, (2) the present and prospective supply of the commodity, and (3) the long-range market possibilities for the product. Other economic aspects of the commodity considered in computing a price support program include: The storage and disposal problems likely to be involved, the relative efficiency of producers concerned and possible alternative sources of income, the number of producers affected, and the implications of precedents that would be established.

"The Board, as a rule, requests the commodity group itself to suggest possible long-time solutions to the problem. The ability and willingness of such a group to carry out suggested solutions is appraised by the Board in considering recommendations."[8]

The marketing committees set up in the United States under the RMA of 1946 constitute a step in this general direction. Secretary Benson's butter industry committee, which he charged with the task of drawing up a workable and economic program for the industry after the present butter price-support program ends in April, 1954, is a still more promising step.

Perhaps we are ready now to consider replacing the term and concept of "Advisory Committees" by a term implying more permanence and power. We can't go as far as "Board of Directors." It may be that "Board of Advisors" would convey the right idea.

These Boards would include representatives of producers of the commodity concerned; producers of closely competing commodities; processors and users (other farmers, industrial users and consumers—domestic and foreign). They would report to the Secretary of Agriculture, who would accept as much of their recommendations as he considered to be in the public interest.

Gradually, as these Boards proved equal to their role as spokesmen and planners for farm products, they could play a part comparable with corporations for business and unions for labor. They could manage their own affairs and relations with other groups, not merely rely on the USDA.

This would be dangerous. It would place power in the hands of private

[8] This quotation is taken from an article by A. H. Turner, secretary-manager of the Agricultural Prices Support Board, Canadian Department of Agriculture, in *Marketing Activities*, PMA, USDA, September, 1951, pp. 6-10.

commodity groups rather than in the hands of the atomistic competitive market supplemented by the USDA. But our general national policy is to place as much power as possible in private hands rather than in governmental hands. The procedure we are recommending for agriculture would be in line with that policy. Our whole economy is becoming increasingly groupistic rather than individualistic.

These Boards would develop production and sale policies, criteria for price-support levels, and other features of a comprehensive program for each commodity, integrated by some form of overhead Board into a consistent program for agriculture as a whole that would be in the national interest. How far their powers could be extended beyond simple recommendation would have to be worked out separately for each product and program. In some cases, their powers might approach those that are provided under existing marketing agreements. In all cases, however, they would be given the responsibility for developing a workable program, beneficial to the producers, distributors, and consumers. If they did not live up to this responsibility, then the PMA would have to do the job; but the Boards would be given the first chance.

This Board of Advisors approach, extending where advisable to a new form of marketing agreement, would have its dangers, but I believe that its good features would overshadow the dangers. It would put the emphasis on comprehensive programs in which price supports and production controls would be only one element, if they were used at all. It would require producers to face up to demand and supply considerations, instead of merely calling for price supports and ignoring the effects of those supports on the quantities demanded and supplied. And it would provide for a self-educational process that would help to replace the shortsighted call for price supports, regardless of their disruptive and often self-destructive effects, by a more comprehensive and rational approach in line with the national interest.

PRICE SUPPORTS AND THE EFFECTIVENESS OF HEDGING

HOLBROOK WORKING
Stanford University

THE title of this paper is descriptive, but perhaps somewhat enigmatic. We shall start by considering a relatively unfamiliar interpretation of reasons for the emergence of burdensome surpluses of storable crops under the agricultural price-support programs. The interpretation will initially be conditional, presented under an unproved supposition that the price-control programs seek to hold price variations within very much narrower limits than would prevail under ideal operation of a free competitive market. After having explored the logical consequences of such "unnatural" restriction of price fluctuations, we shall turn to the question whether the price-control programs have in fact sought to keep price variations much smaller than would occur naturally if competition resulted in the amount of storage of surpluses that it ideally should.

It will be granted, I think, that the price-support programs have sought to hold price fluctuations for storable crops within much narrower limits than actually prevailed in United States markets prior to the adoption of price supports, and I shall offer evidence that, for certain commodities at least, those earlier ranges of fluctuation were not appreciably greater, and were possibly smaller, than should occur under ideal handling of private storage of surpluses. This claim, amounting to assertion that by one reasonable standard price variations between times of surplus and times of shortage were not excessive prior to institution of price supports, may appear difficult to credit. To support it, I refrain from trying to pile up additional statistical evidence, all subject to the same suspicion of possible lack of validity, and choose instead to show why it is reasonable to suppose that private enterprise may indeed have resulted in as much storage of surpluses as could be made to pay its costs. That supposition appears reasonable when the effectiveness of hedging is properly understood.

Effects of "Unnatural" Price Stabilization

When embarrassingly large stocks of wheat or of corn or of cotton, accumulate under a price-support program, it tends to seem obvious that the level of prices which the program maintains is too high—perhaps not too high in every sense, but too high in the sense that it is tending to maintain production in greater volume than consumption. Such an inference, however, may be mistaken. It may be that the burdensome surpluses arise, not because the price-support programs tend to maintain

prices above equilibrium levels on the average, but because the programs seek to hold price variations from year to year within limits that are "unnaturally" narrow.

This observation is made in the belief that the surpluses presently burdening the price support programs may in fact have arisen more because the programs aim at too much price stabilization than because the "parities" on which they are based are too high. But since the causes of particular surpluses, in particular historical settings, are complex and their relative importance difficult to establish, it will serve our purpose better to discuss a hypothetical price-support program rather than to attempt at the outset to appraise the effects of an actual program.

Let us imagine the parity price of wheat to be in fact a long-time equilibrium price, so that if the weighted average price realized and expected by growers over an indefinitely long period of years just equalled the parity price, production over that long period would just equal consumption. Suppose further that no production controls are imposed; that the support level is set, as at present, at 90 per cent of parity, at which level the government takes over any surplus; and that the support measures are so effective that the wheat price never falls appreciably below the support level. To simplify the reasoning, let us suppose also that the price-supporting agency makes no sales, at home or abroad, at prices below parity, and is always a willing seller at the parity price. Since the parity price is an equilibrium price, expensive measures of surplus-disposal are unnecessary. What will be the results of such a support program?

One result of such a support program must be that the price-supporting agency will lose money. Because it pays 90 per cent of parity for the surplus stocks that it acquires, the margin between that price and the prices at which it can sell in times of shortage will be insufficient to cover the costs of storage between times of surplus and times of shortage. For the present this statement must stand as a bald assertion. Evidence will be given later to show that support of wheat prices at 90 per cent of an equilibrium price must result in loss on stocks acquired at that price level even though the stocks accumulated were no larger than would be carried through private initiative in the absence of a governmental support program.

A second result of the support program assumed will be the emergence of a great and persistent surplus stock of wheat. The surplus may emerge initially because of a fortuitous succession of uncommonly liberal harvests, but if it is not so produced, it will still emerge, because of the nature of the support program. Though the parity price is an equilibrium price, the program will give growers sound reason to expect prices in its earlier years to average *above* an equilibrium level. Growers are as-

sured by the program of receiving not less than 90 per cent of parity if their crops are large, and they can count on getting prices 20 per cent or 40 per cent or 60 per cent above parity if their crops happen to be small. Such are the reasonable expectations so long as no great surplus stocks are in existence, and such expectations must sooner or later bring into existence a huge surplus stock.

A third effect of the program is conditional on our assumption that no surplus-disposal is engaged in, involving sales through special channels at prices below the support level, or outright destruction of the commodity. This implies that the government will be willing and able to accept and store surplus stocks in whatever quantity they may appear. Given such willingness and ability, a point will be reached at some stage in the accumulation of surplus when growers realize that, whereas they are assured of never having to take a price below 90 per cent of parity, they are in fact more likely to receive only such a price than a price above parity, and that if by chance their crops are very short, the price received will still not be very much above parity. If this realization comes suddenly, there may of course be a sharp exodus from wheat-growing, but more likely the consequent curtailment of acreage will be gradual, favoring attainment of an equilibrium condition. This equilibrium condition will be one in which large stocks tend to persist, with year-end stocks falling as low as, say, 150 million bushels only when a year of exceptionally poor harvests is followed by a second year of similarly poor crops. Even in such extreme situations the price will not rise very high—only to say 20 or 30 per cent above parity. But usually the price will be either at the parity level or at 90 per cent of parity. A condition of relative price stability as well as of equilibrium will have been reached.

This condition of relative price stability can be maintained only at a heavy cost. We observed at the outset that accumulation of stocks at 90 per cent of parity must tend to result in loss to the price supporting agency. That is true even before there has been accumulation of great and persistent surplus stocks. When stocks have accumulated to the point that prices seldom rise much above parity, only a small part of the costs of storage per bushel will be covered by price appreciation between the times when stocks are acquired and the times when they are sold. Most of the heavy storage costs on huge stocks will fall as a direct burden on the support program. This cost to the government, moreover, will not be accompanied by any corresponding financial gain to producers, or financial saving to consumers. It will be a net cost of attaining an "unnatural" degree of price stability.

One may easily see resemblances between the results of the hypothetical program analyzed above and results actually experienced under price-support programs for storable crops in the United States. Perhaps the

actual parity prices have not been equilibrium prices, but somewhat above equilibrium levels. If so, the discrepancy is of relatively little importance because an accumulation of large surplus stocks would have occurred in either case. The points at which actual events have differed most from those of the hypothetical example are related to willingness of the government to allow stocks to accumulate as called for by the logic of the programs. There has appeared in fact much reluctance to allow stocks to build up to the levels necessary to assure that prices will never rise much farther above parity than they are allowed to fall below it. In consequence our experience includes no case in which there has been a real test of whether the parity price for a storable crop is close to an equilibrium price or not. All that we have had is evidence that when reasonable assurance is given against occurrence of very low prices, production tends to be stimulated at least so long as accumulated stocks are not so large as to assure also that prices cannot rise very high. Lacking recognition of that fact, public reactions tend to be inconsistent; effort to attain substantial price stability is favored, but the expensive stockholding that logically goes with it is resisted. Until the costs of obtaining relative stability in prices of storable crops are more generally understood it will remain impossible to have an informed and meaningful decision as to whether the public is willing to pay the costs of such price stability as our support programs implicitly seek or not.

Appraisal of Current Goals of Stability

From the standpoint of realistic discussion of price-support programs, the pertinence of the foregoing analysis turns largely on the question whether the programs do in fact aim at an "unnatural" degree of price stability. Do they tend to restrict price variation within much narrower limits than they could ideally be held within through private stockholding, which must cover its costs from price appreciation between times of surplus and times of shortage? This is a somewhat complicated question to deal with directly, but there is an indirect approach by which it can be answered, for certain major crops, quite simply. A simple answer is readily available because (1) it is clear that the price-support programs aim at holding price fluctuations within much narrower limits than prevailed previously; and (2) there is existing evidence that for certain major crops, prior to governmental price-intervention, the variations in price between years of surplus and years of shortage were no greater on the average than was necessary to cover the costs of economical storage of surpluses over the intervals between times of abundance and times of scarcity. If the former degree of price variation was no greater than necessary to cover the costs of storage, it follows of necessity that with

prices held within much narrower limits of variation than formerly, costs of storage must fall far short of being covered.[1]

For wheat, there is explicit evidence on the past relations between costs of storage and the amount of price variation between times of surplus and times of shortage. A statistical study of the financial results of the commercial stockholding actually done in the United States prior to 1931 led to the conclusion that such "holding of wheat has, during the past forty-one years, shown more losses than gains."[2] That is, aggregate losses from holding stocks exceeded aggregate gains. Less explicit, but none the less pertinent, evidence is available for corn and cotton as well as for wheat in the form of analyses of price behavior. No such analysis that I know has shown the existence of an historical tendency for prices of any of those crops in times of surplus to be below the levels reached in times of shortage by an amount greater than the cost of storing the commodity over the average interval between periods of surplus and periods of shortage.

Such statistical information has been available for many years, yet the mistaken idea has meanwhile persisted and even gained strength, namely that prices of these crops tended to fall so low in times of surplus that large profits were available to people who had the means and the facilities to accumulate stocks at such times and to hold them until a crop shortage occurred. The prevalent view that historical price behavior allowed opportunity for large profits from judicious storage, and that private initiative failed to provide enough of such storage can be supported by various lines of deductive reasoning. Apparently such mistaken deductions on the basis of influences that seem reasonable to expect though they did not control the outcome, have been more persuasive than the evidence supplied by historical statistics. Let us therefore not merely ask disbelievers to answer the evidence of the statistics, but meet them on their own ground of argument regarding what it is reasonable to expect under private initiative.

Effects of Hedging on Price Stability

Reasoning with respect to the adequacy of stockholding under private initiative in times of surplus has been concerned mainly with commercial stocks rather than with stocks held on farms. With regard to the holding of such commercial stocks of wheat and corn and cotton in

[1] This follows, of course, only if there is not at the same time a substantial shortening of the average storage interval. It is evident from the earlier analysis of consequences of a support program which restricts price variation that it tends to require not only carrying of larger stocks than otherwise, but also a longer average holding period.

[2] Holbrook Working, "Financial Results of Speculative Holding of Wheat," *Wheat Studies*, VII, 417 (July, 1931).

the United States, the reasoning has usually been quite unrealistic in at least one vital respect: it has proceeded on the assumption that the carrying of surpluses depends on finding people who are willing to buy and store the commodity under the inducement of a highly uncertain prospect of subsequent price advance. As a matter of fact, scarcely any commercial storage of surpluses of major farm crops has been so done in the United States since nearly a hundred years ago. For almost a century, commercial storage of such surpluses has been done mainly by individuals and firms that hedged in futures markets. As hedgers, their motivation has been quite different than is assumed in the usual reasoning.

The prevalence of commercial hedging is fairly well recognized by professional economists, but its economic significance has been very poorly understood. In the common view, hedging is merely a means of reducing net risk by assuming more or less completely offsetting risks. This seems indeed to be the nature of some primitive forms of hedging, as for example in connection with gambling, but such a description of modern commercial hedging grossly misrepresents it. We cannot undertake here to explore the nature of commercial hedging in all its several main applications, but we must consider the nature and consequences of hedging as it affects storage of commodity surpluses.[3]

Because of the common view, reference to the effectiveness of hedging, as in the title of this paper, is likely to bring to mind the question of completeness with which risk of loss and chance of gain from holding stocks is avoided by hedging. But the effectiveness of hedging in connection with the carrying of surplus stocks lies primarily in the fact that the hedger obtains substantial assurance of a known return for storage at the time when he undertakes that storage. Moreover, the functioning of futures markets is such that whenever a surplus exists for which commercial holders must be found, price relations in the market offer the hedger a return sufficient to induce the necessary storage.

Consider for example the motivation of an operator of a storage elevator in Kansas City. If he bought wheat for storage, he would sell an equal amount of wheat futures. His interest, therefore, would be not in the current and the prospective subsequent prices of wheat, but simply in the current and prospective subsequent *relations* of spot prices to futures prices. On the first business day of September 1951, for example,[4] spot wheat of the cheapest quality deliverable on futures con-

[3] More extended discussion appears in two largely complementary papers by the present author: "Future Trading and Hedging," *American Economic Review*, June, 1953 and "Hedging Reconsidered," *This Journal*, November, 1953.

[4] That situation is taken for illustration rather than a recent one because there was then a considerable current and prospective surplus of wheat in private com-

tracts in Kansas City sold there at 5¾ cents per bushel under the price of the September future. The price relation for that quality of wheat deserves special consideration, not because a buyer of wheat for storage would be likely to want to make delivery on futures contracts—he would not—but because the price of that quality of wheat is most simply and directly comparable with prices of futures. This discount of spot wheat under the December future appears on its face to give promise that an elevator operator buying in Kansas City at that discount could store the wheat until December 1 and earn a return of 5¾ cents per bushel for storage over the three-month interval. The reasonable prospect was in fact somewhat better than that, for in such a situation spot wheat of this quality in Kansas City has usually sold on December 1 at a moderate premium over the December future. The existing price relations at the beginning of September, therefore, gave the elevator operator a clear prospect, generally recognized by elevator operators, of earning some six to perhaps ten cents per bushel from storage of wheat between September and December.[5] Under such conditions why should there be any difficulty in getting commercial holders to carry surplus stocks of wheat at a reasonable return for storage?

A striking illustration of the effectiveness of hedging in facilitating the private storage of surplus stocks at quite moderate rates of return may be found in the behavior of flour mills. Though most large mills hedge regularly and are quite aware of the returns available from storage of hedged stocks, there is very little tendency for mills to take advantage of opportunities to earn returns from storage. They tend to carry only about enough stocks to fill flour orders on their books. The only reasonable explanation seems to be that commercial wheat surpluses are carried by operators of storage elevators for returns so low that flour mills find it unprofitable to compete in the storage of wheat surpluses.

Conclusions

If we now review the foregoing argument we find it leading to two interesting conclusions of great possible significance for judging the future of price-support programs for storable crops in the United States. We have shown first that if such a price-support program uses a support level which tends to produce an "unnatural" degree of price stability, it must tend to result in the accumulation of very large stocks, which have

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mercial hands, whereas at present so much of the available supply of hard wheats is being held by growers under government loans or in anticipation of taking such loans, or is in the hands of the CCC that there exists a shortage of commercially available supplies of such wheat.

[5] The actual return that would have been realized, as indicated by comparison of spot premiums on September 4 and December 1, 1951, was 6⅜ cents per bushel.

to be carried at heavy cost to the government. Secondly, we have shown that existing price support programs for principal storable crops in the United States do tend to produce a quite "unnatural" degree of price stability, or at least, they must so tend if stock accumulation is not checked by so-called surplus-disposed measures or by restrictions on production.

Proof of the second proposition above has been given by showing that the amount of variation that formerly tended to occur in prices of storable crops in the United States between times of surplus and times of storage was only about as much as was needed to cover the costs of storage, whereas the support programs for these crops aim at holding such price variations within much reduced limits. This suggests our first conclusion, which is that one of the reasons for difficulties encountered by the programs is that they *have been founded on a false premise*, namely, the premise that price variations could be kept within much reduced limits through appropriate management of stocks without tending to incur loss on the stockholding. In fact, it is necessary either to accept heavy governmental losses under the programs, or else to allow the prices to vary much more widely than present programs are supposed to permit.

A second conclusion that may be drawn concerns the course to be followed if and when price-support programs for storable crops demonstrate a tendency to lead to accumulation of stocks that are unmanageably large, or to involve storage expenses beyond what the public is willing to bear. The logical recourse then should not necessarily be a revision of the parity formula; all that is necessary may be a reduction in the price at which governmental accumulation of stocks is undertaken. If the support level at which stocks are acquired is appropriately set, the program will not tend to result in losses on the stocks so accumulated. Indeed, if the support level is so set for crops that have effective future markets, it may reasonably be expected that private initiative will take care of most of the stock-carrying for which there is occasion.

DISCUSSION

JOHN G. McNEELY
Texas A. and M. College

Professor Working has contributed a new definition for hedging together with an excellent analysis of the effects of the price support program on hedging. His analysis is based entirely on wheat.

The definition is that "hedging in futures consists of making a contract to buy or sell on standard terms, established and supervised by a commodity exchange, as a temporary substitute for an intended later contract to buy or

sell on other terms." Under this definition, hedging is carried on (1) to facilitate buying and selling decisions, (2) to give greater freedom for business action, (3) to give a reliable basis for conducting storage of commodity surpluses, and (4) to reduce business risks.

The effect of price supports on hedging is shown to rest largely on (3) above, "to give a reliable basis for conducting storage of commodity surpluses." Prior to the price support program, in years of large supplies, commercial stocks were large and were hedged. Wheat prices tended to fall only low enough to cover the costs of economical storage to times of relative shortage. Speculators are shown to have carried the risks of price changes on this hedged wheat and to have suffered a net loss for performing this function.

The current price-support program has reduced hedging by transferring the storage function to producers through non-recourse loans and to the government through stocks acquired under loans or purchase agreements. This applies only to surplus stocks since other stocks are released by producers or the government when prices rise sufficiently above the support level.

Professor Working believes that historically, wide variations in wheat prices have been brought about by economic forces other than variations in supplies. He believes further that these price variations would not have been modified by a government storage program and that private interests have shown a willingness to provide an economical storage program. He concludes then that any government support program which results in the accumulation of larger stocks at higher prices can result only in substantial losses to the government.

There is no apparent indication then, that price supports have altered the need for, or effectiveness of, hedging in wheat except by reducing stocks in commercial hands. Price risks on hedged wheat borne by speculators have been shifted to the government on surplus stocks but not on supplies remaining in commercial hands.

The price support program, then, has resulted in a new level of futures trading. Back in 1924, 1925 and 1929, futures trading in wheat was near the 16 billion bushel level. During the past five crop seasons ending in June 1952, volume of futures trading in wheat has been 5.8, 4.5, 4.2, 4.7 and 4.3 billion bushels. During the same five years, corn volume has been 3.8, 3.7, 2.0, 2.2 and 2.6 billion bushels. Cotton futures trading has amounted to 111, 63, 53, 79 and 95 million bales. These figures are taken from reports of the Commodity Exchange Authority.

Professor Working makes no attempt to show that hedging as a practice has been either more or less effective as a result of the price support program. His criticism of the program is rather that it has reduced the efficiency of use of storage facilities, introduced certain inflexibilities of supply, and caused processors some inconvenience and added risk. He feels also that it has induced uneconomic storage that cannot be justified in a free enterprise economy. If some income stability is required for wheat producers, his alternative proposal is to let prices vary without supports and to alleviate producer hardships by supplementary payments. This latter proposal is a matter of policy with implications reaching far beyond the scope of this paper. There would seem to be little merit in considering this point other than to express disagreement that this is the best available alternative to the current support program.

It is disappointing that no attempt was made to show relative advantages and disadvantages of hedging when individual farm product prices are above,

on a level with, and substantially below the support level. It would seem that cash purchases or sales at prices above the support level would involve considerably more prospect of substantial price change than would similar transactions below the support level. There have been tendencies for cotton prices, for example, to hover relatively close to the support level for rather long periods of time. Prices were just high enough to pull needed supplies out of farm and government storage. Hedging would seem to add little price stability during such periods.

A recent Title II study of inventory and hedging policies of commercial mixed-feed manufacturers in Illinois, Oregon, Pennsylvania, Tennessee and Texas indicates that factors other than the price support program may limit hedging. "Most of the price risks incurred in inventory accumulations were carried by the feed manufacturers themselves rather than transferred to others. . . . Of the manufacturers interviewed, only a few hedged their price risks through commodity futures; a very limited number did so consistently. . . . Few of the smaller feed manufacturers included in the study understood hedging; this was particularly true on the Pacific Coast. However, many of the smaller feed manufacturers who accumulated large ingredient inventories were conscious of the risks which they incurred and expressed interest in ways to obtain protection against such risks."[1]

Curtailed volume of hedging in the post-war period may be attributable in part to the more stringent regulations under which the individual exchanges are now operating. There is no definite evidence, further, that a lower volume of hedging is necessarily undesirable. Additional facts are required before price supports can be proved to have reduced the effectiveness of hedging.

DISCUSSION

JERRY FOYTIK
University of California at Davis

Price support programs have been discussed frequently and from many viewpoints. What is the accomplishment of 20 years' effort? There is general agreement among economists, politicians, and laymen that governmental interference is needed when agricultural prices decline, or threaten to decline, suddenly and sharply. But there is considerable disagreement as to when action should be undertaken and what should be done. As a consequence, this issue continues in the public eye—and gets in the public's hair.

Professor Shepherd states boldly that "effective, feasible and economic price support programs for perishable farm products can be developed" and outlines a plan of action. I agree with the assertion but not with the entire proposal. His prescription, when first encountered, resembles a novel mixture of Wallace's over-normal granary, Brannan's benefit payments, and Benson's self-help. Some, however, are likely to consider at least one of the ingredients unpalatable or even harmful. They may request the Agricultural Research Administration to conduct a project aimed at improving the flavor and potency

[1] H. S. Irwin and Eileen M. McDonald, *Inventory and Hedging Policies of Commercial Mixed-Feed Manufacturers in the United States*, USDA Agriculture Information Bulletin No. 24, p. ii.

of this medicine before recommending its general use. Although not good to the last drop, the concoction is tempting and exciting. Another sip—a small one, if you prefer—should be tried.

From an examination of the spotty record of price support activities, Shepherd draws two conclusions. First, Section 32 programs are feasible and commendable because purchases are limited to quantities for which immediate outlets are available. The price supporting potential, however, may be higher than Shepherd implies. Purchases usually are directed toward products and localities where farm prices are low—i.e., to those portions of the supply for which demand at the farm level is fairly inelastic. Furthermore, the distribution program could be expanded to cover additional outlets. Secondly, CCC operations have a substantial price effect since purchases are made in accordance with price commitments, regardless of how the quantities are to be utilized. But Shepherd cautions us, and properly so, that, when applied to perishables, CCC programs "are likely to be short lived . . . once a few years experience has demonstrated their uneconomic nature."

Yes, expenditures for potatoes were large. Maybe children should be taught a new nursery verse:

> The lowly Spud, being price support bound, got on the ball,
> The lowly Spud, after half a billion, had a great fall;
> All Uncle Sam's efforts and all Uncle Sam's men
> Cannot bring the lowly Spud under control again.

Shepherd leaves a moral: Any perishable—be it white potatoes, yellow butter or red meat—which strives to become King of CCC programs will have its reign terminated abruptly—and justifiably—by an aroused public resentment.

There can be general agreement with this portion of Shepherd's paper. What recommendations are proposed? First, the objective must be changed. He selects as a feasible goal one designed "to stabilize prices about long-run, free-market levels, without attempting to raise those levels." The idea of having support levels responsive to changes in supply-demand conditions is sound. Making hundreds of separate determinations, however, poses no easy statistical job. Take an illustration. How much has the demand for butter changed during the past decade? What forecast is to be made for the next year or two? Will the dairy farmer accept this indication gracefully?

This formulation of the objective raises other questions. Does price stabilization mean setting both ceilings and floors? If so, what range should separate them? Once prices are stabilized at free-market, or any other, levels, can the government resist pressure to move upward? How are relative prices to reflect locational, seasonal, and grade differentials? In fact, after a period of time, wouldn't the system become one of the administered prices?

Personally, I would feel more comfortable about a more modest objective—though one somewhat above the stop-loss level. This question of the level of support is a major, if not the chief, issue. It deserves more attention than I can spare here.

A three-point program is presented. Feed prices must be stabilized since they loom high in the total costs for the products of the livestock industry. How? An expanded storage program for feed grains is endorsed as the appropriate method for reducing fluctuations in livestock production and prices. In essence, the question is: Will stabilized feed prices moderate the production

and price cycles for meat, eggs and dairy products? Maybe, if other things remain constant. Yet one might wonder whether the variability in beef prices during recent years was caused predominately by changes in feed grain supplies.

An alternate technique is offered for other perishables, such as fruits and vegetables, which are not dependent upon a durable feed crop. Since the hog illustration appears here, I presume Shepherd would agree that benefit payments are also applicable to livestock products. In any case, it seems likely that this treatment will be tried once it becomes evident that the preventive medicine, comforting though it may be for a while, will not cure the patient.

Finally, we come to Shepherd's commodity committee proposal. Secretary Benson's butter industry committee is approved as a promising step in the right direction. Well, perhaps. But I'm a bit pessimistic. Possibly its activities will be accelerated sufficiently to jell a workable and economically sound program by next April. Though I've tried, I can't convince myself that future committees will find it any easier than their predecessors to make recommendations to their own benefit without prejudicing the interests of other farm groups, of middlemen, of consumers, or of tax payers. Using experience as a guide, one might suspect that pressures will be generated to set aside statistically determined results. It will be claimed that the free-market level obtained from figure juggling by bureaucrats is unrealistic because demand is more favorable and costs are substantially higher than those being reflected. Furthermore, the Committee will maintain that individual consideration must be given the special circumstances peculiar to the commodity in question. I'm sure the men operating action programs recognize this line of argument.

I have considerable more confidence in Shepherd's second remedy. A feasible program can be built upon benefit payments. Farm prices can be maintained at whatever levels are deemed needed to attract the volume of production required for welfare purposes or to prevent serious dislocations within agriculture. Simultaneously, prices to the housewife can be kept sufficiently low to clear the market. The method used for paying the subsidies is largely an administrative decision. Benefits may take the form of income supplements to consumers, as was done under the food stamp plan, of government checks mailed directly to farmers, as is done for conservation work, or of supplemental payments to some of the intervening middlemen, as was done during World War II.

Nutritionists point out that the consumption of protective foods is inadequate even during prosperous times. If this is so, welfare considerations warn against reducing the production of perishables. Until distributive costs are reduced sharply, the twin problem of over-production and under-consumption, when it arises, can be attacked by subsidies. The aim should be to improve consumption and not merely to discover better dumping grounds for agricultural surpluses. It is foolish to support farm prices in a manner leading to wholesale waste or necessitating widespread use of other controls designed to avoid the accumulation of embarrassing surpluses.

A benefit payment program will work. Witness our war experience and the longer tests conducted in other countries. Its desirability is another matter. That question must be decided at the ballot box—and not by one of our economic boxes.

USE OF ECONOMIC MODELS

Chairman: R. G. Bressler, Jr., University of California

SOME APPLICATIONS OF ACTIVITY ANALYSIS IN AGRICULTURAL ECONOMICS*

RICHARD A. KING**
North Carolina State College

AS AGRICULTURAL economists, our work frequently concerns the scarce resources which are bound together in a farm. We commonly make the assumption that the administrative process is carried on by the farmer in such a way as to maximize dollar profit from the use of these resources. Given this assumption, one type of problem which the farmer faces is selecting that combination of inputs which, in view of the limited resources at his disposal, will give him the largest possible difference between some cost function and some revenue function. In theory, this process is quite straightforward. In practice, our theoretical framework is sometimes forgotten. It is the primary purpose of this paper to draw the attention of agricultural economists to the possibilities of a new analytical tool which may aid in solving some practical problems in agriculture.

Possible Techniques For Estimating

Suppose we wish to determine the combination of two inputs (or groups of inputs) which will result in that output providing maximum net income. We need first the best possible estimate of the entire surface relating inputs X and Y to output. Secondly, we must select the desired point from among the available alternatives.

We have several different techniques for analyzing this situation where the administrator of a given bundle of resources must decide what the proper combination of these resource inputs is, and what bundle of products he should produce in order to maximize money profit. Four possible techniques for estimating the surface and selecting the desired point are:

1. The use of budgets to estimate cost and revenue for particular points on the surface,
2. The mathematical estimation of the complete production function, cost function, and revenue function,
3. The estimation of isoproduct contours for particular segments of the

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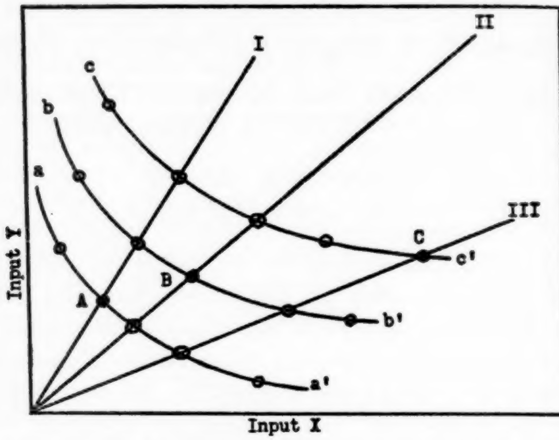

FIG. 1.—ALTERNATIVE TECHNIQUES FOR DETERMINING THE RELATIONSHIP BETWEEN INPUTS X AND Y AND OUTPUT

surface to which relative price lines may be applied to determine the optimum combination, and

4. The use of activity analysis to select the best combination of specified activities which require constant input ratios.

These four techniques can be compared through reference to Figure 1. We plot a single input or group of inputs X along the horizontal axis, and a second input or group of inputs Y along the vertical axis. Output is measured in a third direction.

The first method of determining the point of maximum profit uses budgets to estimate cost and revenue for particular points on the surface. Although this type of analysis is often used when relatively few input combinations (sizes of farm) are considered, this is not always the case.[1] In Figure 1, A, B, and C represent what might be small, medium and large farms in this type of analysis. However, even for those resource bundles which are selected, there is no test to assure one that the most profitable farm program has been found.

The second technique, that of estimating the complete production function, calls for the fitting of a mathematical equation to a number of different points on the surface, such as are represented by the circles in Figure 1. Given a particular production function, or mathematical relationship, it is possible to estimate the parameters of that equation from the data and thereby construct a continuous production function.[2]

[1] See, for example, Richard G. Wheeler, "New England Dairy Farm Management Project as an Example of the Operating Unit Approach to Farm Management Analysis," *This Journal*, Vol. XXXII (1950), pp. 201-215.

[2] See, for example, Earl O. Heady, "Production Functions from a Random Sample of Farms," *This Journal*, Vol. XXVIII (1946), pp. 989-1004.

It is possible to do this using several different equations, although it is often difficult to get any definitive measure as to which equation is superior to the others. Appropriate cost equations may then be developed, and for each cost-price situation, maximum profit may be found mathematically. For this type of estimation of the cost function, it is desirable to have large numbers of observations and a wide distribution of that information over the entire surface.

The third type of analysis calls for the estimation of the marginal rate of substitution between the two inputs at one or more levels of output. We wish to determine what combinations of input X and input Y will provide a given output as suggested by curves aa′, bb′, and cc′ in Figure 1.[3] To determine at what rate we can substitute one input for another without affecting the total product, we may sketch in free-hand curves, or fit one or more mathematical equations to the data. In any case, we attempt here to estimate contour lines for the production surface. It is desirable that there be several observations, each resulting in a given level of output, but using different input combinations. Relative price lines then indicate for each level the best input ratios, from which the maximum profit combination among those considered can be selected.

Finally, we may use activity analysis. In contrast to the third type of analysis where we required estimates of the shape of curves representing constant *output,* here we require estimates of the slope of straight lines representing constant *input ratios.* Based on a single point on the line, it is assumed that estimates can be made for all other points on the line. In Figure 1, radial lines I, II, and III represent three alternative activities or processes, each of which it is possible to carry on at a large number of levels.[4]

It can be seen that any of these four methods for estimating physical input-output relations, cost functions associated with particular factor prices, and finally net revenue, will provide information concerning the point of maximum net income. Which of the four is most appropriate depends upon the nature of the production function involved, and the quantity and type of data which can be obtained. Now let us examine in somewhat more detail the analytical framework for activity analysis.

Activity Analysis

Activity analysis is a procedure by which it is possible to select from among given alternatives the best possible production program for a

[3] See, for example, John C. Redman, "Economic Aspects of Feeding for Milk Production," *This Journal,* Vol. XXXIV (1952), pp. 333-345.

[4] See, for example, Clifford Hildreth and Stanley Reiter, "On the Choice of a Crop Rotation Plan," *Activity Analysis of Production and Allocation,* Ed. T. C. Koopmans, New York (1951), pp. 177-188.

specified set of fixed resources. Assume that we are concerned with a farm having certain fixed resources and wish to select that production program which will maximize profits. Given a number of alternative activities, we wish to select the level at which each is to be carried out. Again referring to Figure 1, we select any one or a combination of activities I, II, and III. Those activities which do not appear in the final production program are (obviously) carried on at zero level. The only type of variation allowed is thus over-all scale.

The production process in activity analysis has rather special characteristics. Clearly, to be defined as a single process, two productive events must use the same technique. Grass fed beef clearly require a different technique from grain-finished animals. In addition, the ratio of inputs to each other and to output must be identical. Although fed the same kind of corn and of the same breeding, two lots of hogs fed to 180 and 220 pounds would represent different processes, since the input-output ratios would be different.

In the linear type of activity analysis, each process is assumed to be divisible—that is, each process may be carried out at any multiple of the basic unit or activity. Output on one or more inputs can be varied only if all vary in the same proportion.

It is also necessary to assume that these processes are additive. This means that any two activities which are carried out simultaneously will be simply the sum of those activities if they were carried out singly. Any complementary relationships would have to be treated by setting up an additional process for each combination of the two taken together.

Whether or not these assumptions are realistic depends upon the particular problem at hand. That they are often approximated has been frequently shown, perhaps most recently by Hans Brems in the *American Economic Review*.[5]

A final comment concerning the shape of factor supply curves may be in order. In marginal analysis, a curve gently rising upward and to the right is commonly assumed. In activity analysis some inputs may be available in unlimited quantity at the going market price while others are available at no cost up to a certain maximum, beyond which they are not available at all. This, of course, is a reflection of the fact that we are concerned with an economic unit having a finite capacity. Several illustrations of the use of this technique may clarify the general form of the analysis and indicate the types of conclusions which may be drawn.

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[5] Hans Brems, "A Discontinuous Cost Function," *American Economic Review*, Vol. XLII, No. 4, September, 1952, p. 577.

Maximization of Income

Let us take as our first example the maximization of income on a broiler farm. The question we wish to pose is "To what age shall I feed my broilers in order to get the largest possible income?" This decision clearly is associated with the number of chicks to purchase since floor space requirements, and hence the capacity of a poultry house in terms of number of birds, is related to the size (age) to which they are grown. It also includes decisions on breed, strain, and sex of chicks which we ignore here.

Activity analysis requires first that an input-output budget be prepared for each activity, or process, to be considered. Input-output budgets for broilers sold at five different ages are summarized in Table 1. In these budgets, a constant amount of floor space is provided per pound of broiler produced. That is, 11 week old broilers weigh 9/10ths as much as 12 week old broilers and are allowed 9/10ths as much floor space per bird. Total Pen Space is equal to the number of chicks started (in this

TABLE 1. INPUT-OUTPUT BUDGETS FOR BROILERS SOLD AT FIVE DIFFERENT AGES. 1000-CHICK BATCHES*

Item	Production Process (Activity)					
	A	B	C	D	E(i)	E(ii)
Age when sold (weeks)	8	9	10	11	12	
Floor space per bird (sq. ft.)	0.59	0.68	0.79	0.90	1.00	
Total Pen Space (sq. ft.)	590	680	790	900	1000	same
Total Pen Time[a] (sq. ft. weeks)	5900	7480	9480	11700	14000	
Feed consumed:						
Amount per bird sold (lbs.)	5.2	6.5	8.0	9.5	12.0	
Total feed consumed (cwt.)	49.9	62.3	76.4	90.4	114.0	
Total feed cost[b] ($)	279.44	348.88	427.84	506.24	638.40	same
Cost of 1000 chicks	185.00	185.00	185.00	185.00	185.00	
Litter & fuel cost[c] ($)	20.00	20.00	20.00	20.00	20.00	
Total direct cost ($)	484.44	553.88	632.84	711.24	843.40	
Number of birds sold[d]	960	958	955	952	950	
Pounds sold per bird.	2.2	2.6	3.0	3.4	3.8	same
Total pounds sold	2112	2491	2865	3237	3610	
Price per pound (¢)	32	32	32	32	32	35
Cash receipts ($)	675.84	797.12	916.80	1035.84	1132.20	1263.50
NET REVENUE[e] ($)	191.40	243.24	283.96	324.60	311.80	420.10

* Based on George G. Judge, "Poultry Marketing Statistics, Sept. 1952," University of Connecticut Agricultural Extension Service, Storrs, Conn.

[a] An additional 2 week period allowed for cleaning and restocking after each batch.

[b] Feed cost assumed $5.60 per cwt.

[c] Litter and fuel cost assumed 2¢ per chick started.

[d] Mortality of 5% assumed for 12 week old birds. One-half of this assumed to occur during first two weeks and balance equally divided over last 10 weeks.

[e] Return to operator's labor and capital after direct cash costs for chicks, litter and fuel, and feed are deducted.

case 1,000) times the space required per bird. Total Pen Time represents the total Pen Space multiplied by the number of weeks during which the poultry house is occupied by a particular batch. In this analysis, a two-week clean-out period is provided following each sale, although this is not a common practice in some areas, and works to the disadvantage of the birds sold at younger ages. The remaining inputs, including chicks, feed, litter, and fuel are self-explanatory. Likewise, output data are fairly clear.

Net Revenue is the difference between direct cash costs listed above and total receipts. Net Revenue represents the return to the operator for his labor and capital.

TABLE 2. INPUTS REQUIRED TO PRODUCE $1000 NET REVENUE, BROILERS SOLD AT FIVE DIFFERENT AGES

Inputs	Unit	Production Process					
		A (8 wks.)	B (9 wks.)	C (10 wks.)	D (11 wks.)	E[a] (12 wks.) (i)	E[a] (12 wks.) (ii)
1. Chicks	(no.)	5225	4111	3522	3081	3207	2380
2. Pen Space	(sq. ft.)	3083	2796	2782	2773	3207	2380
3. Pen Time	(thous. sq. ft. weeks)	30.8	30.8	33.4	36.0	44.9	33.3
4. Feed consumed	(cwt.)	260.7	256.1	269.1	278.5	365.6	271.4
5. Production Capital[b]	($)	2531	2277	2229	2191	2705	2008

[a] Sale price (i) 32¢ per lb., (ii) 35¢ per lb.
[b] Includes chicks, litter, fuel, and feed. (chicks—$18.50/cwt.; litter and fuel—2¢/bd.; feed, $5.60/cwt.).

It will be seen that when all birds sell for 32¢ Net Revenue *per 1,000 chicks* is greatest for eleven week old birds, decreasing for 12 week old birds and for birds kept 10 weeks or less. When 12 week birds bring a 3¢ premium, E (ii), 1,000 chicks sold at this age becomes most profitable. However, income may not be maximized over a year's time or in all resource situations by growing 11 week old birds.

To maximize income over a given time period, additional analysis is required. Each of these activities (A through E) are expressed in terms of inputs (resources) required to produce a specified amount ($1,000) of net revenue in Table 2. It seems reasonable to assume that Pen Time and Production Capital are the two important limiting factors in broiler production, although other assumptions could be justified under specific situations. We find that with equal sale prices for all ages, Price Situation (i), only B, C, and D need be considered, since A and E use more of both fixed resources than one or more of these three. Under Price Situation (ii), only B and E need to be considered (Table 3). We can now de-

TABLE 3. POSSIBLE PROFITABLE PRODUCTION PROCESSES WHEN PEN TIME AND PRODUCTION CAPITAL ARE LIMITED ($1000 UNITS)

Limiting Resource	Unit	Price Situation (i)[a]			Price Situation (ii)[b]	
		B	C	D	B	E(ii)
Pen Time	(thous. sq. ft. weeks)	30.8	33.4	36.0	30.8	33.3
Production Capital	($)	2,277	2,229	2,191	2,277	2,008

[a] All broilers selling at 32¢ per pound.
[b] Twelve week birds selling at 35¢ per pound; all others at 32¢ per pound.

termine graphically under what conditions each of these single processes will maximize income.

If we plot the combinations of Pen Time and Production Capital which yield $1,000 Net Revenue (Figure 2), it is possible to show graphically the single most profitable broiler production process for any resource combination. The straight lines going through the origin indicate combinations where it is a matter of indifference which of two processes is selected. Net Revenue is directly proportional to the distance from the origin. Dashed lines correspond to 52,000 square foot weeks. It will be observed that only E and A fail to maximize income at some resource combination under Price Situation (i).

What sort of conclusions can be presented to farmers? The following prescription is possible for Situation (i):

1. If you have more than $3,600 of production capital available per 1,000 square feet of poultry house, Process B will maximize income;

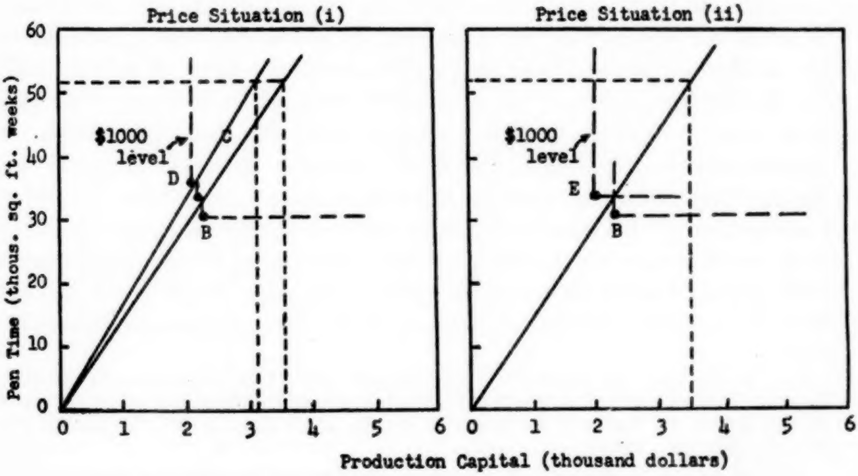

FIG. 2.—PROFITABLE BROILER PRODUCTION PROCESSES FOR VARIOUS LEVELS OF PRODUCTION CAPITAL AND PEN TIME

2. If you have available between \$3,200 and \$3,600 production capital per 1,000 square feet of poultry house, Process C will maximize income;
3. If you have available less than \$3,200 production capital per 1,000 square feet of poultry house, Process D will maximize income;
4. Stay away from Processes A and E.

For Situation (ii) we may prescribe as follows:

1. If you have more than \$3,600 production capital per 1,000 square feet, choose Process B.
2. If you have less than \$3,600 production capital per 1,000 square feet, choose Process E.
3. Stay away from Processes A, C, and D.

This suggests that in an area where feed dealers and hatcherymen supply a large amount of the capital used in broiler production, we would find birds sold at light weights (Process B) while in areas where individual growers provide much of the capital, birds would be sold at heavier weights (Process E).

A second graphic application of this type of analysis was made in evaluating alternative small grain rotations in Eastern North Carolina.[6] Fourteen possible one-year rotations were considered. Of particular interest was a comparison of small grain-lespedeza with a small grain-soybean rotation. Ignoring the labor factor, the ratio of production capital to land that would leave the farmer indifferent whether to grow soybeans alone or in rotation with oats would be \$24.50 per acre of land. For farmers with more than this amount of capital available, soybeans in rotation with wheat or oats would result in larger incomes.

The third application I would like to discuss concerns the selection of an optimum combination of enterprises on a family farm with 60 acres of cropland in the Northern Tidewater of North Carolina.[7] Here we use the mathematical maximization process that is the heart of activity analysis. In our first attempt, we considered only six enterprises: Irish potatoes, corn, soybeans, cropland pasture used for beef production, fall lettuce, and fall cabbage. The fixed resources included cropland, production capital, and a specified number of days labor on the part of the farm operator. The time available for field work was estimated by months from weather data for the area. Product prices were based upon projected 1955 prices. Factor prices at the 1951 level were used. It was assumed that the operator owned a tractor and two row equipment. Potato har-

[6] A. B. Mackie, "An Economic Evaluation of Small Grain Rotations in the Costal Plain of North Carolina," A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics, North Carolina State College, Raleigh (1953).

[7] Based on "A Case Study in Linear Programming," unpublished manuscript by R. A. King, R. J. Freund, C. W. Harrell, and D. L. Wilson, North Carolina State College, Raleigh (1953).

TABLE 4. BASIS III, WITH ACTIVE PROCESSES P_1, P_4, P_6; and D_1, D_4-D_8 ($100 UNITS)

	B_{11}	Active Processes									B_{12}	Inactive Processes						S
		D_1	D_4	D_5	D_6	D_7	D_8	P_6 Lettuce	P_4 Beef	P_1 Potatoes		P_2 Corn	P_3 Soybeans	P_5 Cabbage	D_9	D_2	D_3	
Fixed Factors	1	1							2.776	1.199	Sp. Land	1.382	3.663					60. acres
	4		1							2.878	J-F labor	2.128						315. hours
	5			1						2.398	M-A labor	2.708						448. hours
	6				1					2.158	M-J labor	4.561	10.523					479. hours
	7					1					J-A labor		7.582	4.198				388. hours
	8						1	2.717			S-O labor		1.596	9.215				424. hours
	9							5.877			N-D labor	4.146	1.334	4.391	1			359. hours
	2							.220	2.776		F. Land	1.382	3.663	.482		1		60. acres
	3							.116	.755	1.192	Prod. Cap.	.522	.723	.361			1	20. $100
	B_{11}^{-1}	Active Processes									Q_1	Inactive Processes						X_1
		D_1	D_4	D_5	D_6	D_7	D_8	P_6	P_4	P_1		P_2	P_3	P_5	D_9	D_2	D_3	
Active Processes	D_1	1						.047	−.726	−1.006		NOT NEEDED						13.187
	D_4		1					.023	.657	−2.414								350.457
	D_5			1				.019	.547	−2.012								447.496
	D_6				1			.017	.492	−1.810								478.547
	D_7					1												388.000
	D_8						1	−.462										258.030
	P_6							.170				.705	.227	.747	.170			61.086
	P_4							−.013	.360			.442	1.302	.114	−.013	.360		16.773
	P_1							−.008	−.228	.839		.089	−.240	.158	−.008	−.228	.839	.213
	V'_1	0	0	0	0	0	0	1	1	1	V'_2	1	1	1	0	0	0	R
	P											−.237	−.289	−.019	−.149	−.132	−.839	78.072

vesting was assumed contracted. Harvest expenses were excluded from production capital, but all other direct cash expenses were included.

As in the earlier examples, a budget for each enterprise was constructed, assuming constant direct cash costs per unit. These budgets were then converted to a unit basis ($100 Net Revenue). The procedure outlined by Dorfman[8] was then followed to select first the best single process and, through an iterative procedure, to arrive at the production program which could be shown mathematically to result in the highest possible income. The simplex criterion requires that the opportunity cost of each excluded process be zero or negative. Although the mechanics at first may appear frightening, the most challenging part of the whole analysis lies in the initial selection of appropriate prices and establishing acceptable input-output relationships.[9]

The results of the third and final iteration for a one-man 60 acre farm with $2,000 of production capital are shown in Table 4. The production program (B_{31}) includes early Irish potatoes (P_1), beef (P_4) and fall lettuce (P_6). Completely used up are inputs of November-December labor (9), fall land (2), and production capital (3). Matrix B_{32} shows the inactive processes. Factor supply is listed in the S vector. Matrix B_{31}^{-1} has little economic significance, but Q_3 shows the inactive processes in terms of the active processes in such a fashion that we get in P the opportunity cost of excluded processes and imputed prices of exhausted inputs. Subtracting the values below the dotted line in Q_3 from V_2' gives negative opportunity costs for P_2, P_3 and P_5 of $23.70, $28.90, and $1.90 respectively. The value of an additional hour of November-December labor is $14.90, an additional acre of fall land $13.20, and an additional $100 of production capital is $83.90. Vector X_3 shows the level at which each process is carried out; those above the dotted line being unused fixed factors and those below the line representing Net Revenue associated with P_6, P_4, and P_1 respectively. This program results in total Net Revenue (R) of $7,807.20.

Some of the results of this analysis are quite interesting. First, it is now clear why statements concerning optimum enterprise combinations must be related to a particular resource bundle. Second, in practice, these optimum production plans frequently will not completely exhaust the fixed resources. Third, the imputed prices which are determined simultaneously with the most profitable production plan are useful in determining the profitability of expanding the original resource bundle.

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[8] Robert Dorfman, *Application of Linear Programming to the Theory of the Firm*, University of California Press, Berkeley, 1951.

[9] Journal Paper No. 503, North Carolina Agr. Exp. Station, entitled "A Procedure for Solving a Linear Programming Problem" by the present writer and R. J. Freund shows in some detail the mechanics of this analysis.

It is of interest that imputed prices for all factors which are incompletely used up are zero, since the addition of a unit of these factors would add nothing to net revenue.

Work is now underway to expand this analysis in terms of land resources, number of alternative enterprises, and variability of income from each process.[10]

Implications of Technique

Finally, we may ask "What implications does this new technique have for agricultural economics?" In research, it provides a mathematical test to indicate whether or not the most profitable production program has been selected from among the alternatives considered. It provides a new technique for using information now available in production departments. Although present data may be poorly suited to estimating a production function, the data may be adapted to a comparison of a limited number of specified techniques of production. Activity analysis serves to emphasize the need for specifying the make-up of the resource bundle owned by farmers, and provides a method for indicating the profitability of new combinations or larger-sized resource bundles. Finally, it can be a tool for analyzing the impact of public programs upon a farming area.

This technique may require some reorientation of our production economics courses in order to take full advantage of the information which it provides. Application to consumption and demand has not been discussed here, but immediately suggests itself. The need for the addition of matrix algebra to the economists' mathematical kit soon becomes apparent.

Not only is activity analysis useful in research and teaching, but it provides an excellent method for presenting information to farmers. The general form of this technique is being tried in North Carolina in helping farmers decide between alternative courses of action.[11] In North Carolina and the whole Southeast where changing production and marketing patterns are the rule rather than the exception, farmers need to consider alternatives which often differ substantially from present practices. When these alternatives are outlined in the form of specific resources needed to provide a given income, these alternatives may become much more real to the producer than would be possible using some other types of analysis.

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[10] The effects of price changes and income variability are discussed in a paper "The Selection of Farm Enterprises: A Case Study in Linear Programming" by R. J. Freund and the present writer to be read at the summer meetings, Econometrics Society, Kingston, Ontario.

[11] G. R. Cassell and J. M. Hunter, "$1000 or More from Livestock," Tarheel Farm Economist, Department of Agricultural Economics, Agr. Extension Service, Raleigh (July, 1953).

AN APPLICATION OF THE USE OF ECONOMIC MODELS TO THE DAIRY INDUSTRY*

ANTHONY S. ROJKO
Bureau of Agricultural Economics

THE dairy industry is complex and any analysis involving the study of its economic structure needs some systematic method by which information as to its relevant elements can be ferreted out. It is in this light that economic models are used in commodity analysis. Perhaps the term "analytical model" would be more appropriate because economic models are essentially constructed to aid researchers in solving their problems.

What then is an economic or analytical model? I like to look upon it as a blueprint of the existing economic structure, drawn in such a way that one can more readily establish the structural relationships among the economic variables for that portion of the economy under study. Because it is a still picture of the relationships, a given model necessarily assumes constant structural relationships among all the economic variables. Stated another way, the structural parameters for the economic variables must have specific values or must be functions of specific values and the segment under consideration must be endogenous in nature so that its economic variables will move along a certain path or will behave in some specified way until or unless disturbed by external forces.

Economic models are to the econometrician what blueprints are to the designing engineer—both are designed for a specific task. The individual parts must be simple enough to be manageable as a research tool, yet the whole must include all the relevant and significant economic elements of the situation needed to link together the many decision-making units. In addition, the assumptions underlying the model must be explicitly stated. Further, the assumptions must permit realistic answers, for that is the true test of the "goodness" of the model. Thus the model will be only as good as the assumptions assigned by the maker. But the characteristic nature of a specific model, particularly as a tool of the commodity analyst, depends considerably on the purpose or use intended for the model. Likewise, the most efficient way of expressing a particular model, either pictorially or mathematically, depends on its use and users.

This paper discusses some applications to the dairy industry of models as analytical tools. The discussion is divided into two main sections: (1) Models designed primarily to aid in the identification of associations among the economic variables; and (2) models designed in such a way

* The research on which this paper is based was made under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

that with given assumptions and available data, estimates for the parameters or coefficients can be determined by statistical methods.

Models as Aids in Identifying Economic Associations and Relationships

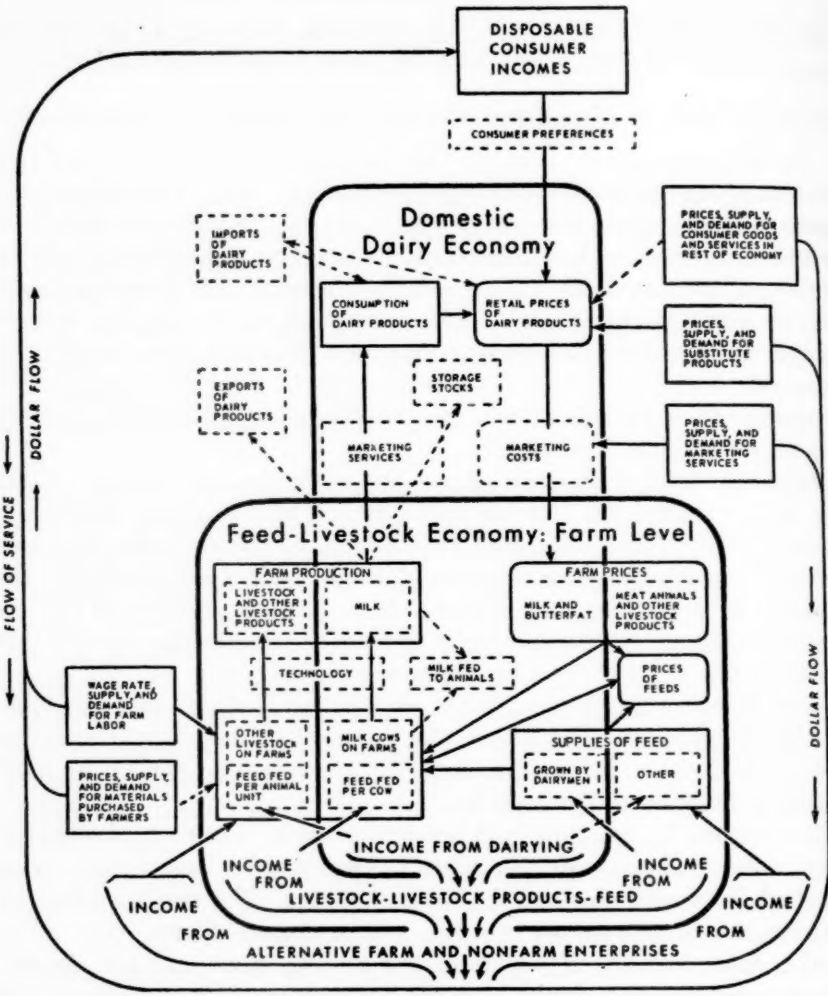
One major perplexing problem that faces a commodity analyst is that of identifying significant economic associations and relationships. He needs methods that will assure the inclusion of relevant factors in statistical analyses and will help him to interpret the statistical results. If the goal is identification of economic relationships, the economic model may be presented by means of a block diagram. Block diagrams may be looked upon as pictorial presentations of the associations among the economic variables. Their main advantage is that they portray the economic structure without the need of establishing quantitative relationships.

Figure 1–a block diagram–shows the economic relationships within the dairy industry and between the dairy and feed-livestock economy in relation to the total economy. In addition to showing the economic influences that affect economic decisions of firms and households, the diagram is constructed in such a way that the paths of flows of services are suggested. From the standpoint of economic theory, the flows reflect group action on the part of firms and households.

Two features are emphasized in Figure 1: (1) Disposable consumer income is shown as the dominating economic influence affecting the dairy industry; and (2) the dairy industry is shown as a part of the feed-livestock economy at the farm level.

Because the income flow in dairying is small in relation to the income flow in the total economy, consumer income may be looked upon as an external influence affecting the dairy industry. The specific effect of changes in income on dairy products will be discussed later.

The dairy industry is a part of the feed-livestock economy in two major ways. The first results from the competition of dairy farmers with producers of livestock and other livestock products in the use of feed. The price of feed and the quantity available to the dairy farmer depend on the total demand and supply for feed in the whole livestock economy. In any given year, supplies of feed are determined mainly by the acreage used for feed crops, including hay and pasture, and the yield per acre. The number of livestock fed on farms during the year depends primarily upon the supplies of feed on hand and the relation between feed and livestock prices. But the number of cows kept for milk depends not only on the price of milk in relation to feed prices but also on the price of milk in relation to prices of meat animals. The latter directly affects the culling rate among milk herds. Likewise, in some areas farmers readily shift between keeping milk cows and feeder cattle. Also there is consider-



ARROWS INDICATE DIRECTION OF INFLUENCE; THOSE SHOWN IN DASHED LINES INDICATE INFLUENCES WHICH NORMALLY ARE OF MINOR IMPORTANCE IN CAUSING YEAR-TO-YEAR CHANGES

FIG. 1.—A DIAGRAM OF THE MAJOR ECONOMIC INFLUENCES AFFECTING THE DAIRY INDUSTRY

able fluidity between number of cows kept for milk and number of other livestock kept, especially on farms that combine several livestock enterprises. Therefore, the price, supply, and demand for meat animals can be considered the second main economic link. Figure 1 also indicates that production of milk is directly affected by income flow from dairying in relation to income flows from other livestock enterprises and to a lesser extent by income flows from other agricultural and nonagricultural enterprises.

Specific Models for Dairy

One of the more useful aspects of block diagrams is that they serve as excellent starting points for the development of economic models which form the bases for statistical analyses. The rest of the paper shows specific models that have been developed for the dairy industry and the way in which block diagrams were used in constructing them.

A Simplified Single Equation Model

Let us examine Figure 1 more closely to see whether any clues are given as to the types of relationships needed to explain the price, supply, and demand structure for all dairy products. The striking feature is that few two-way relationships result when aggregate supply and demand are considered. The diagram also suggests lags in the adjustment of production to price. Thus, in any given period, production of milk affects the price of milk received by farmers but price does not affect current production to a significant degree. Likewise, the block diagram suggests that if the effects of changes in the quantity of milk fed to animals, in storage stocks and in the import-export balance on dairy prices are insignificant, then production and consumption could be used interchangeably in statistical analyses. This appears to be approximately true in the interwar period. Since aggregate milk production is considered as given, the supply equation for total milk becomes a fixed constant in analyses of the price and demand structure. Thus a single equation model will explain the economic structure under the above assumptions. The demand equation might read: Price is a function of consumption (or production), consumer income, price or supply of substitutes, and consumer habits that change gradually over time.

For the interwar period, several demand equations for total milk at the retail level were fitted by least-squares techniques, using calendar year data for 1924-41. The economic variables were the same in all the analyses but they were expressed in either current or constant dollars and as actuals, first differences of arithmetic values, or first differences of logarithms. The results of the statistical analyses are shown in Table 1 and the economic variables entering into the relationships are explained below.

P_D—Bureau of Labor Statistics index of retail prices of dairy products on a calendar year basis is used as the dependent variable. A composite price was used on the assumption that all dairy prices under equilibruim conditions are closely related and differ only by some constant or proportionately as a result of differences in marketing costs and conversion factors in converting milk into dairy products.

Z_M—BAE estimates of per capita disappearance of total milk, in pounds per calendar year are used for the consumption variable. It was

assumed that per capita estimates of disappearance (consumption) derived from calendar-year data would not differ significantly from estimates derived from marketing-year data (April through March). It was also assumed that disappearance was equivalent to production on a marketing-year basis in the interwar period because the carry-over in stocks from one marketing year to another and year-to-year changes in the net import-export balance each were small in relation to changes in total production of milk. These assumptions permit using disappearance as an exogenous or given variable in the analyses.

Z_I—Per capita personal disposable income, in dollars per calendar year is used as a demand shifter.

Z_T—Time is included in analyses using actual data.

The results show a remarkable uniformity in the price flexibility (inverse of elasticity) coefficients. This coefficient was higher in the logarithmic analysis than at the mean values for the corresponding arithmetic analysis. It was also higher in analyses using constant rather than current dollars. Likewise, analyses based on first differences gave a higher value for this coefficient.

The above demand equation for total milk at the retail level may also be considered a price-forecasting equation for the interwar period. It is inadequate as such a device for the postwar period unless some modification is made to include the impact of the fats and oils economy on the dairy industry. This aspect will be discussed later.

Structural Models Involving Three Equations

A study of the price, supply, and demand structure for individual dairy products cannot be handled by a simplified single-equation approach. Statistical analyses expressing price for each individual dairy product as a function of consumption (or production) and income have resulted in stable income coefficients but not stable supply (or consumption) coefficients. Such analyses implied that consumption was given. However, production (and therefore consumption) of one dairy product depends on that of other dairy products because all must be produced from the supply of milk which for any given year is assumed to be fixed. Equations (1) through (3) below form a three-equation structural model which takes into account the simultaneous determination of the quantities in each of the specified dairy products.

$$P_D = \alpha + \beta Z_M + \delta Z_I + U_D \qquad (1)$$
$$Q_F = a_F + b_F P_D + c_F Z_I + V_F \qquad (2a)$$
$$Q_M = a_M + b_M P_D + c_M Z_I + V_M \qquad (2b)$$
$$Z_M = Q_F + Q_M \qquad (3)$$

In these structural equations, the two economic variables not discussed above are the BAE estimates of per capita disappearance of fluid milk and cream (Q_F) and per capita disappearance of manufactured products (Q_M), both in pounds of milk equivalent per calendar year. U_D, V_F, and V_M are random disturbances.

Equation (1) applies to the aggregate demand for milk at the retail level. It is identical to the equation used in the single-equation model and is subject to the same assumptions. There is no supply equation for total milk because it is assumed that supply for any year is given.

Equations (2a) and (2b) are demand equations for fluid milk and cream and manufactured dairy products respectively. The assumptions involved in using the same composite price in each equation were discussed earlier.

The quantity in each outlet becomes known only after equilibrium has been reached in the dairy industry. At equilibrium, the demand for fluid milk and cream (Q_F) and the demand for manufactured milk (Q_M) are assumed to equal the supply of total milk (Z_M). This condition is shown by the identity expressed by equation (3).

If equations (2a) and (2b) are added together, Z_M is substituted for ($Q_F + Q_M$), and the terms are rearranged so that P_D becomes the dependent variable, the resulting equation cannot be distinguished statistically from equation (1).[1] Therefore, the structural model includes three equations: Equation (1), equation (2a) or (2b) and equation (3).

The coefficients of this system of linear equations can be estimated algebraically from the coefficients of the predetermined variables in the "reduced-form" equations. These values are estimated by fitting the reduced-form equations by least squares. As the system of linear equations is just identified,[2] the estimates from the reduced-form method are identical to the estimates that would be derived from the "maximum likelihood" method.

The reduced-form equations for estimating the coefficients in the above structural model are:

$$P_D = \alpha + \beta Z_M + \delta Z_I + U_D \quad (4)$$

$$Q_F = (a_F + b_F\alpha) + b_F\beta Z_M + (c_F + b_F\delta) Z_I + (V_F + b_F U_D) \quad (5a)$$

$$Q_M = (a_M + b_M\alpha) + b_M\beta Z_M + (c_M + b_M\delta) Z_I + (V_M + b_M U_D) \quad (5b)$$

[1] The equation reads:

$$P_D = -\frac{a_F + a_M}{b_F + b_M} + \frac{1}{b_F + b_M} Z_M - \frac{c_F + c_M}{b_F + b_M} Z_I - \frac{V_F + V_M}{b_F + b_M}.$$

[2] "An equation in a system of linear equations is said to be identified if it is not possible to derive another linear relation, involving exactly the same variables as the equation in question, from linear combinations of some or all the equations of the system. A quick rule for establishing necessary but not sufficient conditions for identifiability of a particular equation in a linear system is that the number of variables in

TABLE 1. LEAST SQUARES ESTIMATES OF THE CONSTANTS AND COEFFICIENTS IN EQUATIONS DESIGNED TO ESTIMATE INDEX NUMBERS OF RETAIL PRICES OF SELECTED DAIRY PRODUCTS (1935–39=100), BY TYPE OF ANALYSIS, BASED ON DATA 1924–41

Type of analysis[b]	Coefficient of multiple determination	Constant or intercept value	Effect on index of product prices of a unit change in: Disappearance of total milk (Pounds per person)[c]			Disposable personal income (Dollars per person)[d]			Time (1924=1)			Price elasticities
			Net effect	Standard error	Coefficient of partial determination	Net effect	Standard error	Coefficient of partial determination	Net effect	Standard error	Coefficient of partial determination	
All dairy products[a]												
I	0.98	142.77	[e]−0.1110	0.0550	0.23	0.1242	0.0074	0.95	−1.2808	0.1292	0.88	
II	.91	−1.1514	− .1606	.0568	.36	.1191	.0116	.88				
III	.89	178.69	− .1393	.0421	.44	.0720	.0091	.82	− .3280	.1028	.42	
IV	.84	− .2821	− .1528	.0381	.53	.0764	.0118	.75				
Fluid milk and cream[f]												
I	.95	55.45	[g]− .0114	.0582	.00	.1084	.0079	.93	[g]− .1595	.1367	.09	
II	.84	− .0912	[g]− .0894	.0617	.13	.0999	.0126	.82				
III	.93	106.21	[g]− .0561	.0367	.14	.0547	.0079	.77	.7242	.0895	.82	
IV	.71	.7569	− .0898	.0351	.32	.0496	.0109	.60				
Butter[f]												
I	.97	308.82	− .3400	.1080	.41	.1823	.0146	.92	−2.2938	.2530	.85	
II	.87	−2.0698	− .3258	.0983	.44	.1611	.0201	.82				
III	.91	313.86	− .3388	.0992	.45	.1548	.0215	.79	−1.7092	.2421	.78	
IV	.84	−1.6706	− .3184	.0813	.52	.1674	.0252	.76				
Average price of American cheese and evaporated milk[f]												
I	.98	113.67	[g]− .0605	.0686	.05	.1280	.0093	.93	−2.1909	.1609	.93	
II	.91	−1.8587	− .1672	.0572	.38	.1242	.0117	.89				
III	.87	152.32	[g]− .0910	.0599	.14	.0702	.0130	.68	−1.0975	.1463	.80	
IV	.81	− .8914	− .1621	.0449	.48	.0821	.0139	.71				

TABLE 1. *Continued*

All dairy products[a]												
		Per cent[h]	*Per cent*[h]	*Per cent*		*Per cent*[h]	*Per cent*		*Per cent*[h]			*Per cent*[h]
I			− .8122			.6180			− .0117			−0.2773
II		− .0105	−1.1746			.5923						− .3097
III			−1.1148			.3582			− .0033			− .3940
IV		− .0028	−1.2232			.3797						− .4369
V	.93	− .0040	−1.2568	.3723	.45	.6046	.0479	.92				− .3570
Butter[f]												
V	.93	− .0072	−2.5863	.5979	.57	.9197	.0769	.91				
Fluid milk and cream[f]												
V	.89	− .0002	[g]− .7228	.4260	.17	.5335	.0548	.87				

[a] Index of all retail prices of dairy products, BLS, per calendar year.
[b] Key to nature of data used in analyses:
I—Actual data in current dollars.
II—Year-to-year changes of actual data in current dollars.
III—Actual data in constant dollars, prices, and income deflated by CPI.
IV—Year-to-year changes of data in constant dollars.
V—Year-to-year changes of logarithmic values of data in current dollars.
[c] BAE estimates of civilian disappearance of total milk in pounds per person per calendar year.
[d] Per capita estimates of disposable personal income in dollars per calendar year, BAE and Department o Commerce.
[e] Coefficient differs significantly from zero when tested at the 10 per cent level but not at the 5 per cent level.
[f] Index numbers of prices applicable to quantities consumed in farm households and by all nonfarm people computed by BAE.
[g] Coefficient does not differ significantly from zero when tested at the 10 per cent level.
[h] The coefficients in the lower section of the table show the effect on product prices (in per cent) of a 1 per cent change in the disappearance of total milk and disposable personal income and of a unit change in time. These estimates were derived as follows: (1) In analyses I to IV, these coefficients (in per cent) were computed at the mean values of the economic variables from the coefficients of the equations which are shown in the upper section of the table and (2) the coefficients in analysis V were the least square estimates from analyses using first differences of logarithms.

Equation (4) is the same as equation (1) of the structural model. Equation (5a) is derived by premultiplying equation (1) by the coefficient b_F and adding the new equation to equation (2a). Equation (5b) is derived similarly by premultiplying equation (1) by b_M. Price (P_D) and the quantities (Q_F and Q_M) are expressed as functions of given or previously determined variables. Therefore, each equation can be fitted by the least-squares technique.

The following formulas are used to derive the structural coefficients from those in the reduced-form equations:

$$
\begin{aligned}
b_F' &= \frac{[\beta b_F]'}{\beta'} \\
b_M' &= \frac{1 - \beta' b_F'}{\beta'} \\
c_F' &= [c_F + b_F\delta]' - b_F'\delta' \\
c_M' &= -[c_F + b_F\delta]' - b_M'\delta' \\
a_F' &= [a_F + b_F\alpha]' - b_F'\alpha' \\
a_M' &= -[a_F + b_F\alpha]' - b_M'\alpha'
\end{aligned}
$$

It can be seen that a series of other three-equation models similar to the one needed for estimating the price and income coefficients for fluid milk and cream and manufactured dairy products as an aggregate can be used to provide estimates of price and income elasticities for other dairy products. For example, one model could give estimates of elasticities for butter and all milk excluding butter.

Tables 1 to 3 summarize the results of several analyses used to estimate the structural coefficients for fluid milk and cream, butter, manufactured dairy products excluding butter, and all manufactured dairy products. Table 1 presents estimates for the coefficients of the reduced-form price equations for equation (4) in the model which was discussed earlier.

Table 2 summarizes the estimates from the reduced-form quantity equations. The estimates for the coefficients which show the effect on consumption of butter and manufactured products excluding butter of a unit change in disappearance of total milk were found to have the correct sign and to differ significantly from zero when tested at the 5 per cent level. Similar coefficients involving the consumption of fluid milk and cream differ significantly from zero when tested at the 8 per cent level and were of the correct sign in the analyses using actual data in both current and constant dollars. But the same estimates from the first difference analyses were of wrong sign and almost zero value. These coeffi-

the entire system (endogenous plus all predetermined variables, counted separately) minus the number of variables in that particular equation be at least as great as the number of equations in the system less one." See Lawrence R. Klein, *A Textbook of Econometrics*, Row, Peterson and Company, 1953, page 96.

TABLE 2. LEAST SQUARES ESTIMATES OF THE CONSTANTS AND COEFFICIENTS IN THE "REDUCED FORM" EQUATIONS DESIGNED TO ESTIMATE PER CAPITA DISAPPEARANCE OF SELECTED DAIRY PRODUCTS, IN POUNDS OF MILK EQUIVALENT BY TYPE OF ANALYSIS, BASED ON DATA 1924–41

Type of analysis[b]	Coefficient of multiple determination	Constant or intercept value	Effect on consumption of a unit change in: Disappearance of total milk (Pounds per person)[c]			Disposable personal income (Dollars per person)[d]			Time (1924=1)		
			Net effect	Standard error	Coefficient of partial determination	Net effect	Standard error	Coefficient of partial determination	Net effect	Standard error	Coefficient of partial determination
Fluid milk and cream[a]											
		Pounds	Pounds	Pounds		Pounds	Pounds		Pounds	Pounds	
I	0.51	211.27	[e] 0.1437	0.0753	0.21	0.0218	0.0102	0.25	−0.4514	0.1765	0.32
II	.01	− .0856	[f] − .0114	.1025	.00	[f] .0076	.0210	.01			
III	.51	202.71	[e] .1505	.0773	.21	[e] .0349	.0168	.24	− .6982	.1888	.49
IV	.02	− .1689	[f] − .0112	.1016	.00	[f] .0130	.0314	.01			
Butter[a]											
I	.91	34.71	.4659	.1058	.58	− .0617	.0143	.57	−2.5861	.2480	.89
II	.75	−2.6280	.6599	.1213	.68	[e] − .0509	.0248	.23			
III	.90	59.88	.4459	.1101	.54	− .0994	.0239	.55	−1.8845	.2689	.78
IV	.75	−2.1828	.6677	.1207	.69	[e] − .0758	.0374	.23			
Manufactured dairy products excluding butter[a]											
I	.95	−245.98	.3904	.0823	.61	.0399	.0111	.48	3.0375	.1931	.95
II	.52	2.7136	.3515	.0957	.49	.0433	.0196	.26			
III	.95	−262.59	.4036	.0851	.62	.0645	.0184	.47	2.5827	.2080	.92
IV	.51	2.3517	.3435	.0961	.48	[e] .0628	.0297	.24			

[a] BAE estimates of per capita disappearance of selected dairy products in pounds milk equivalent per calendar year.
[b] See footnote b, table 1.
[c] See footnote c, table 1.
[d] See footnote d, table 1.
[e] Coefficient differs significantly from zero when tested at the 8 per cent level.
[f] Coefficient does not differ significantly from zero when tested at the 10 per cent level.

TABLE 3. CONSUMPTION OF SPECIFIED DAIRY PRODUCTS: ESTIMATES OF PRICE AND INCOME ELASTICITIES AND COEFFICIENTS FOR "TIME" BASED ON SINGLE- AND THREE-EQUATION MODELS, BY TYPE OF ANALYSIS, BASED ON DATA 1924–41

Type of analysis[a]	Estimates of price elasticities from single equation models[b]	Estimates from three-equation models[c]						
		Price elasticities based on:			Income elasticities based on:		Time (Per cent per year) based on:	
		Composite price[d]		Individual product prices[e]	Composite price[d]	Individual product price[e]	Composite price[d]	Individual product prices[e]
		Unadjusted	Adjusted					
Fluid milk and cream								
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
I		−0.42	−0.63	f	0.30		−0.63	
I & II[g]	−0.19	− .29	− .34	−0.50	.21	0.30	− .44	−0.18
III		− .32	− .48	− .77	.17	.27	− .32	.37
III & IV[g]	− .27	− .29	− .34	− .48	.16	.18	− .29	.17
V	− .19							
Butter								
I		−1.31	− .84	− .45	.72	.29	−2.28	−1.64
II	− .32	−1.29	− .96	− .66	.68	.43	−2.11	−1.95
III		− .92	− .58	− .39	.19	.15	− .84	−1.18
IV	− .25	−1.25	− .92	− .62	.37	.39	− .98	−1.63
V	− .27							
Manufactured dairy products excluding butter								
I		−3.29	−2.88	f	2.22		−1.26	
II	− .85	−2.05	−2.14	−2.05	1.41	1.42	.17	−1.02
III		−2.48	−2.16	f	1.16		1.40	
IV	− .68	−1.92	−2.00	−1.89	1.00	1.01	1.47	.40
V	− .90	(Evaporated milk)						
V	− .29	(American cheese)						
All manufactured dairy products								
I		−1.81			1.09		−2.02	
II		−1.48			.87		−1.54	
III		−1.31			.43		− .28	
IV		−1.42			.53		− .36	

[a] See footnote b, Table 1.

[b] Estimates were computed from regression analyses using price as a function of consumption and income. Only butter in analyses II and V, evaporated milk are statistically significant.

[c] Computed at the mean values of the economic variables from the coefficients in the structural demand equations. Coefficients in the demand equations were computed from the coefficients in the reduced-form equations shown in Tables 1 and 2.

[d] BLS index of retail prices of all dairy products, calendar-year average. Use of the composite price results in biased estimates (unadjusted) because of differences in the price flexibility among dairy product prices. To correct for this bias, the estimates were based on least square analyses designed to measure the relative price flexibilities.

[e] See footnote f, Table 1.

[f] The coefficient in the reduced-form equation which measures the effect on price of a unit change in disappearance of total milk does not differ significantly from zero when tested at the 10 per cent level.

[g] Based on coefficients in structural demand equations which were computed by taking the least squares estimates of the coefficients in the reduced-form equations from the actual and first difference analyses, using in each case the one having the highest coefficient of partial determination.

cients in the first difference analyses probably reflect the small year-to-year changes in the per capita disappearance of fluid milk and cream. The change in level over this period was sufficient to permit measurement of this response when using actual values. The income coefficients for the reduced-form equation for fluid milk and cream did not differ significantly from zero in the first difference analyses when tested at the 10 per cent level but when actual values were used they differed

significantly from zero when tested at the 5 and 6 per cent level. The estimates of the income coefficients in the other reduced-form quantity equations differed significantly from zero when tested at the 5 per cent level except for two first difference analyses for butter which were statistically significant at about the 6 per cent level.

On the basis of the estimates for the reduced-form equations shown in Tables 1 and 2, the coefficients for the structural equations were computed by algebraic formulae as discussed earlier. From these values, the price and income elasticities and the time trend in percentages were computed. They are shown in the first column of each of the latter three sections in Table 3.

The use of the composite price introduced a downward bias in the price elasticity of fluid milk and cream and an upward bias in the elasticity for all manufactured products because of the difference in the flexibility of prices for fluid milk and cream and butter (Table 1). If prices at the retail level for two commodities are closely related and differ only by the degree of flexibility present, the coefficients that are affected by price changes can be adjusted directly by a conversion factor which represents the relationship between the price flexibility of the product concerned and the price flexibility of all dairy products. Such factors were determined by least squares analyses and the price elasticities were adjusted as shown in the third column in Table 3. After adjustment, the price elasticities, which ranged between −0.6 and −1.0 for butter, appear reasonable. For fluid milk and cream, this coefficient ranged between −0.5 and −0.6 and may be a little high. The adjusted price elasticities for all manufactured products were greater than unity and probably are too high. No such adjustment is needed in connection with the income elasticities and the time coefficient.

Some of the values for fluid milk and cream in Table 3 were computed using estimates from reduced-form price equations fitted to data based on year-to-year changes and from reduced-form quantity equations fitted to actual data. This was done on the assumption that these were the best estimates for each set of coefficients. These coefficients ranged between −0.3 and −0.4 and appear reasonable.

A further modification in the structural coefficients was made to take into account the bias introduced by the use of a composite price. If we continue the assumption that all prices are related at the retail level, the errors are minimized by using prices for individual products in the reduced-form equations instead of adjusting the coefficients for the relative price flexibilities. If no error term were involved, this method and the previous one should give identical results. The estimates derived from using prices of individual products in the reduced-form price

equations are also shown in Table 3 and the estimated parameters of these equations are shown in Table 1. The results of this approach raise the elasticity coefficients for fluid milk and cream, but considerably lower the coefficients for butter. Substitution of the individual prices for the composite price should not have affected the income elasticity or the coefficient for time. However, differences were found, particularly for butter. These variations can be assumed to be caused by factors similar to those causing sampling variations.

Price elasticities computed from single equation models are shown in column 1 of Table 3. They were found to be substantially lower than those derived from three-equation models.

Of the products studied, the income elasticities for the consumption of fluid milk and cream were found to be the lowest, particularly in the analyses using constant dollars. Income elasticities for butter ranged between 0.2 and 0.7. Income elasticities for the other manufactured dairy products were unity or greater and in one analysis was over 2. The latter probably includes a trend effect, as that particular analysis had a downward trend in consumption. Some of the products in this group, for example, evaporated milk and cheese, had pronounced upward trend values during this period. Based on family budget data, Fox found the income-expenditure elasticity for all dairy products excluding butter to be 0.3.[3]

Models for the Postwar Period

The models discussed so far have severe limitations in their applications in the postwar period because of the increasing importance of margarine and filled-milk products. Some exploratory analyses based on limited time series data have been run in an attempt to measure the effect of the fats and oils economy on the dairy industry. The interrelationship between the dairy and the fats and oils economy can be shown by two separate two-equation structural models, one for butter and one for margarine. These structural equations are listed below:

$$P_B = \alpha + \beta Z_M + \lambda Z_O + U_B \qquad (6)$$
$$Q_B = a_B + b_B P_B + d_B Z_O + V_B \qquad (7a)$$
$$Q_O = a_O + b_O P_B + d_O Z_O + V_O \qquad (7b)$$

The symbols not yet identified in the above model are P_B, Q_O and Z_O. They represent the price of butter, the per capita consumption of margarine and the price of margarine, respectively. Equation (6) is the price-

[3] Karl A. Fox, "Factors Affecting Farm Income, Farm Prices, and Food Consumption," U. S. Bureau of Agricultural Economics, *Agricultural Economics Research*. 3:65-82. 1951.

TABLE 4. LEAST SQUARES ESTIMATES FOR CONSTANTS AND COEFFICIENTS IN "REDUCED-FORM" EQUATIONS NEEDED FOR SOLUTION OF PARAMETERS OF STRUCTURAL EQUATIONS IN POSTWAR MODELS FOR BUTTER AND FOR MARGARINE, BASED ON DATA 1946–52

Type of analysis[b]	Coefficient of multiple determination	Constant of intercept value	Effect on price and consumption of a unit change in: Disappearance of total milk (Pounds per person)[c]			Retail price of margarine (Cents per pound)[d]		
			Net effect	Standard error	Coefficient of partial determination	Net effect	Standard error	Coefficient of partial determination
Retail price per pound of butter[a]								
		Cents	*Cents*	*Cents*		*Cents*	*Cents*	
I	0.76	161.59	[e]−0.1475	0.0549	0.64	[e] 0.6716	0.2913	0.57
II	.94	.2287	[e]− .1561	.0600	.82	.8910	.1530	.87
Consumption per person of margarine[f]								
		Pounds	*Pounds*	*Pounds*		*Pounds*	*Pounds*	
I	.91	731.42	−.8359	.1352	.91	[g]−.1573	.7179	.01
II	.51	9.8407	[g]− .2606	.2492	.36	[g] .7727	.6356	.17
Consumption per person of butter[h]								
I	.69	−146.02	.4365	.1537	.67	[g] .8534	.8160	.21
II	.56	3.0903	[g] .6516	.3277	.55	[g] .2186	.8360	.09

[a] BAE estimate per calendar year.
[b] See footnote b, Table 1.
[c] See footnote c, Table 1.
[d] BLS estimate per calendar year.
[e] Coefficient differs significantly from zero when tested at 10 per cent level but not at 5 per cent level.
[f] BAE estimate per calendar year in pounds product weight multiplied by 20.
[g] Coefficient does not differ significantly from zero when tested at the 10 per cent level.
[h] BAE estimate in pounds milk equivalent per calendar year.

generating equation or the demand for butterfat and is similar to equation (1) using individual product prices in the interwar model. The postwar model includes the substitution effects between butter and margarine by including the price of margarine in the equation. Income as a demand shifter was left out because of the short time period for which data were available (1946-52). Equations (7a) and (7b) are the demand equations for butter and margarine, respectively; the quantity in each is expressed as a function of its own price and the price of its substitute. Equations (6) and (7a) comprise the butter model, while equations (6) and (7b) form the model for margarine.

The coefficients for these structural equations are computed by methods discussed previously from the estimates of the coefficients in the reduced-form equations (8), (8a) and (8b). It was assumed that the price of margarine is determined mainly by the fats and oils economy and therefore given in this analysis.

$$P_B = \alpha + \beta Z_M + \lambda Z_O + U_B \qquad (8)$$
$$Q_B = (a_B + b_B\alpha) + b_B\beta Z_M + (d_B + b_B\lambda) Z_O + (V_B + b_B U_B) \qquad (8a)$$
$$Q_O = (a_O + b_O\alpha) + b_O\beta Z_M + (d_O + b_O\lambda) Z_O + (V_O + b_O U_B) \qquad (8b)$$

The reduced-form equations were fitted by the least squares method using data expressed either as annual values or as yearly changes of annual values for 1946-52 and the results are shown in Table 4. From these estimates price and cross elasticities were computed. In the analyses using annual data, the price elasticities were −1.13 and −1.15 for butter and margarine, while their cross elasticities were 0.48 and 3.73, respectively. In the first difference analyses, the price elasticities were −1.59 and −.21 for butter and margarine, while their cross elasticities were 0.66 and 1.10, respectively. Some of the difference in the lower elasticities in the first difference analyses probably can be explained by the high trend value in the first difference equations, which showed butter increasing about 2 per cent a year and margarine increasing 9 per cent a year around their respective means.

The significant observation to be gained from this exploratory analysis is that the consumption of butter is affected more by its price than by the price of margarine. Second, the elasticity of demand is more elastic than for the interwar model. This is logical because it recognizes the increased substitution effects of margarine on butter. It also shows that consumption of margarine is quite sensitive to changes in butter prices, considerably more so than to its own price. Because of the short period used, these elasticities should be used cautiously. Further, as the trend in butter was mainly down and the trend in margarine up during this period, it is doubtful that a price reduction in butter would bring about an increase implied by the above price elasticities. More specifically, these elasticities may be true for the shift from butter to margarine but not in the other direction.

Summary and Conclusions

The final test of an economic model is whether the model accomplished the specific task for which it was designed. It was shown that block diagrams were useful in presenting associations among economic variables.

Using the block diagram as a starting point for the development of specific models, a single equation and a three-equation structural model were developed for the interwar years. It was found that a single equation model could be used to explain the demand and price structure for total milk but that a three-equation model was needed to explain the demand and price structure for individual dairy products. It was also found that single equation models could be satisfactorily used for forecasting prices of individual dairy products. Price elasticities estimated from single equation models were found to be substantially lower than the estimates from the three-equation model.

Explorations with the simplified postwar models to estimate the price and cross elasticities of butter and margarine are encouraging. Because of the increasing importance of margarine and filled-milk products, future analyses of the demand and price structure of the dairy industry will need to include more fully the effects of competing products as well as interrelationships among dairy products.

DISCUSSION

J. D. SHAFFER
Michigan State College

Dr. King has presented a very interesting paper showing the application of a relatively new and important technique of analysis to agricultural economics. He has presented two specific examples of the use of this technique. Two of the examples were relatively simple and provided for definite solutions, by graphic methods, of problems which might otherwise have been handled by a budgeting procedure. In the two simple examples the problems involved the selection of the most profitable of several alternative activities or possibilities under various conditions. Actually this technique as used here by Dr. King is an extension of the budgeting procedure providing for definite answers without the use of trial-and-error approximations. In a third example a more complex problem was considered where the solution involved the selection of the most profitable combination and level of activities. The latter solution required the introduction of a mathematical procedure, new to most economists, which involves the solution of a system of linear inequations by means of matrix algebra.

It is evident that two things are involved in this technique. First of all, it is an approach to economic analysis. The *emphasis* is placed upon the *processes* or *activities* of economic life rather than on the marginal units of input and output. Secondly, mathematical procedures have been developed to handle complex economic models orientated to this approach to economic analysis.

Assumptions of Linear Programming

It should be noted that at present the mathematical techniques limit the nature of the economic model. These restrictions were mentioned by Dr. King as assumptions of constant input ratios, additivity and divisibility, etc. These are the assumptions of *linear* programming and should not be imposed upon the concept of activity analysis since this approach does not exclude the possibility of using non-linear models. It is only the linear programming type of model and technique of analysis which is being considered here.

Since linear programming is a relatively new technique, we do not know its full possibilities or limitations. It is likely that these limitations and possibilities will only be revealed through the extension of applications and their critical evaluation. These three specific applications presented by Dr. King suggest both further possibilities and limitations.

Of prime importance in the use of any technique or model in economic research is the data to be used. It is here that linear programming has its

greatest immediate advantage as far as agricultural economic research is concerned. The advantage comes from the fact that most of the physical input-output data is in a form usable in linear programming. The crops and husbandry scientists do not think in terms of marginal units and have not conducted their research so as to provide marginal data. Besides, the cost of obtaining marginal data is very high—often too high to be practical. Even in the classical case of fertilizer application the data is not provided in the form of a continuous function. The soils or crops specialist runs replicated plot experiments with relatively large variations in the amounts of fertilizer used on the different plots. This data is best adapted to analysis by linear programming taking each level of fertilizer application as a separate process. This type of analysis has the further advantage of being in closer harmony with the way farmers make decisions than is the case with marginal analysis. The results should therefore be more easily extended.

The type of data used and the assumptions of the model limit the precision of the results. In most problems the answer obtained will represent only a close approximation. In the broiler problem, for example, only weekly intervals were considered. It is possible that 11 weeks, 2 days, and 3 hours would be a more profitable period. It is obvious that such a solution was made impossible by the nature of the data used and the method of analysis. The assumption of linearity or constant return to scale simplify the problem but may also introduce a bias. The nature and extent of this bias depends upon the nature of the problem and the data used. The bias can be reduced by introducing additional processes. If a high degree of accuracy is required, linear programming might be used to determine the appropriate range in which to get marginal data, thus reducing the cost of experimentation.

Danger of Over-Generalizing

There is the danger of over-generalizing from this analysis the same as from any other. For example, in the problems dealing with the selection of a crop program, Dr. King has used some average input-output relationships (or average yields) for the various crops considered. Now we all know that yields will vary between farms, especially where soils and cultivation practices vary. Thus the analysis would be strengthened considerably by offering a solution under various circumstances of relative yields of the crops considered. Why can't we put out results in a form which will enable the farmer to determine his expected yields from past experience on his own farm and then consult a set of tables for the best crop combination under various conditions. This would make the results applicable to specific farms in place of the usual non-existent average farm.

Similarly, in King's applications, a specific set of price relationships has been selected and solutions found in terms of these price relationships only. The analysis should be extended to show the farmer at what price relationships it would pay to change from one crop to another. This information would be of considerable value to our extension men in presenting outlook information inasmuch as they could show the practical value of their information in planning a farm organization. This general approach can be used especially well in respect to the choice of an optimum feed ration where it can be shown that a small change in price relationships may change the optimum ration considerably. Price indifference lines can be constructed based upon physical substitution data to show which of two or more feed substitutes is

the best buy under different price conditions. This type of work has been done very well by Schruben and others at Kansas State where they have also extended the type of analysis illustrated by Waugh in his paper on linear programming.

King's examples are static in the sense that prices are given and no allowance is made for uncertainty or price expectations. *If uncertainty were considered, certainly less lettuce* (and perhaps none at all) would be included in the crop plan of his third example. There is no particular reason why this uncertainty cannot be included in the model, however. Such criteria as an assured minimum cash receipt with probabilities assigned to price expectations can, at least theoretically, be added to the model.

King's third example is particularly suggestive of further possible applications of this technique. The possible application to price policy is especially interesting. With the selection of model farms, programming problems could be worked out to show the most profitable adjustments to such things as acreage allotments. If these could be worked out ahead of policy decisions, the probable effect on total production of a number of alternative crops could be estimated. An evaluation of the total effect of alternative programs ought to contribute to a better policy.

Applications on Consumer Side

This technique appears to have applications on the consumer side also. For example, Stigler could have arrived at a more precise determination of his minimum cost diet using the linear programming technique. In addition, linear programming presents the opportunity to add specific requirements which could be used to insure the resultant diet would be edible or even appetizing. The problem need not be restricted to that of obtaining a minimum diet either, but could be expanded to the problem of obtaining diets meeting specific requirements given a limited food budget.

The technique also has applications in marketing research and appears to be especially suited to such problems as the determination of optimum combinations of products to be produced by a diversified dairy plant where the problem is one of determining how much butter, cheese, cottage cheese, cream, dried milk, etc. to produce under changing price and supply conditions.

It appears also that this technique could be added to the analysis of packing plants used by Bressler and others at California. Here they have found the conditions of constant returns to scale to exist; i.e., the functions are linear and discontinuous. This is the type of data for which linear programming is best suited. In these studies, however, the technique has not been used primarily because each stage of operation is assumed to be independent of every other stage and the problem then becomes one of simply selecting the one best process for a particular stage. Since the studies are in terms of the long-run, no consideration is taken of limiting factors. *If* the studies were extended to apply to existing plants, however, limitations would have to be considered. For example, a plant with limited floor space would have to consider the amount of floor space taken up by each of the alternative processes of all the stages in order to determine the optimum selection of processes. Similarly, restrictions on the amount of capital or skilled labor would affect the optimum combination of processes even in a one-product plant.

DISCUSSION

D. A. CLARKE, JR.
University of California

Mr. Rojko presents his definition of an economic or—as he prefers to call it—an analytical model, and discusses the application of two such models to research in the dairy industry. He further illustrates the use of one of these models in a specific application to a statistical analysis of supply and demand in the dairy industry.

Qualitative Identification—Determination

The two models discussed in this paper are intimately related in one sense. The first model involves the qualitative identification of the important economic variables. The second involves the quantitative determination of the nature and extent of the relationships. Together these perform the two steps necessary in statistical analyses, namely, (1) specification and (2) measurement.

I am in disagreement with only one of Rojko's statements. He mentions that two points stand out from the block diagram: (1) disposable consumer income appears as the dominating economic influence affecting the dairy industry and (2) the dairy industry is shown as a part of the feed-livestock economy at the farm level. This implies that this feature of the block diagram gives the researcher information otherwise not known concerning the nature of the problem under study. I submit that these features stand out because they were drawn that way—presumably as a result of logical reasoning on the part of the researcher himself or some colleague. This block diagram technique is, however, an effective method of presenting the complex nature of these relationships.

Usefulness of Simultaneous Equations Technique

Mr. Rojko makes use of a simplified application of the much discussed simultaneous equations technique. As a nonstatistician I have little constructive to offer on this subject in terms of added comments or appraisal. It is my feeling, however, that this is a highly promising general approach to the determination of the interrelationships between supply and demand. Such a technique is required in the dairy industry, where several products—each with different demand characteristics—are produced from a common raw material. In the example presented, aggregate data of prices and products are used. This fact limits the application of the conclusions of this particular study as they can be applied only to broad, industry-wide and nation-wide problems. This can clearly be overcome through modifications which would allow the application of this technique within limited geographical areas and between specific products. It is well brought out in the paper that, if the model is to be applied to a different time period in which new influences, or changes in the importance of other variables, have come about, adjustments can and probably must be made in the specific form of the model. It has been demonstrated, to my satisfaction, that the technique is flexible and, in the hands of a wide-awake researcher, it offers considerable opportunity for research in a highly important area.

Tests of the validity of results from this technique are subject to the same limitations as those from other statistical measures of supply and demand

relationships. For the most part, the tests are subjective and, where objective, they provide only a limited evaluation. These tests consist of (1) a logical appraisal of the direction and magnitude of the coefficients and (2) a statistical evaluation of the significance of the coefficients. If the sign is incorrect or if for any reason the size of the coefficient is unacceptable, the analysis is presumably scrapped. It is due to this limited possibility for evaluation—in addition to the limitations imposed by the short period from which data were obtained—that the interesting conclusions concerning the interrelationships between butter and oleomargarine prices are accompanied by the usual warning to use them with caution.

Use of Models in Research

My own concept of a "model" is probably broader than Rojko's as defined in his paper. He considers a model to be a specific form which establishes constant structural relationships among all the economic variables—or, in a sense, entirely as a measuring device. To me, an economic model consists of a framework which is both logical and statistical and which provides means for the attack of a problem. Since most economic problems are exceedingly complex, some simplification is required to eliminate part of these complexities to bring the problem to manageable proportions. One function of a model is to bring about this simplification. [Obviously, however, it must not oversimplify to the point where the resulting conclusions become invalid.] A second function of a model may be to provide "norms" or "benchmarks" which can be used to make pertinent measurements. A third function of a model is to provide the bases upon which the structural relationships discussed in this paper may be specified.

The term "logical framework" implies theory—and correctly so in my opinion. However, I would not say that the aggregate of accepted theory—or any part of it as we know it—in itself constitutes a model. My thought is that models can, and in fact must, be drawn from theory.

Several models based on theory have been successfully used in research in the dairy industry. For example, models drawn from production economics have formed the "hard core" for research in costs and efficiency in processing plant operations and in studies of milk distribution. Such a model was used in the study of butter-powder plants in the Northwest. This study was recently completed by the Idaho and Oregon Experiment Stations in cooperation with the Farm Credit Administration as a part of the Western Regional Dairy Marketing Project. A model drawn from the same theory was also used in the milk delivery cost studies included in the Connecticut series on Efficiency in Milk Marketing.

The whole body of theory known as "pure competition" has provided models for many studies of pricing efficiency within the dairy industry. The "perfect market" model has been used successfully by Rojko in the Bredo-Rojko study of price interrelationships in northeastern fluid milk markets. This same general model has been extended to include interproduct, as well as intermarket, price relations by J. B. Hassler in his study of the manufactured dairy products industry which will soon be issued in the *Hilgardia* series of the California Experiment Station.

These are only limited examples of two broad areas where economic models have been used. They have been used with success in the sense that they have

made it possible to carry out some of the better and more fundamental research in the dairy industry. Similar models show promise toward solving still further, problems of both physical efficiency and efficiency of the price-making mechanism. Examples of such uses include studies of methods of organization, economies of scale, and the discovery of new and more efficient techniques and/or innovations. In addition, they prove helpful in determining guides to the appropriate levels of producer milk prices used for manufactured products and levels of the butterfat differential. They also help devise procedures to account to producers on the utilization of both the fat and skim components of milk. And finally, they solve problems of establishing resale pricing schedules developed to reflect the nature of costs. These costs may be delivery costs or any other costs which may be non-uniform between customers receiving different volumes, between different types and size of containers, or between different types of customers.

Summary

In summary, Rojko has done a good job of illustrating the application and usefulness of two analytical techniques which are particularly well adapted to the dairy industry. I hope that his efforts will serve to stimulate added work along these lines. Knowing some of Rojko's interests in problems of intermarket price relationships, I was surprised that he did not choose to also discuss the application of some of the theory models to the dairy industry.

BLUEPRINTING A PROGRAM FOR IMPROVING CROP AND LIVESTOCK ESTIMATES

Chairman: W. A. Hendricks, Bureau of Agricultural Economics

PLANNING WITHIN AGRICULTURAL ESTIMATES FOR A WORKABLE MODERNIZATION PROGRAM

S. R. Newell
Bureau of Agricultural Economics

PLANNING within Agricultural Estimates has been a popular in-door sport for a long time.

About 23 years ago, I cornered an Assistant Chief of the Bureau of Agricultural Economics and poured forth my complaint. We were not doing what we should in the way of providing information, nor were we using the right kinds of methods. At that time, I was particularly interested in the fruit crops and in the general subject of weather and yield relationships. I was advocating a plan to supplement the condition report made by voluntary crop reporters by the use of what we called "fruit cruisers" at that time.

We were securing the usual reports on the per cent of a full crop from a large number of producers. But in analyzing the returns we ran into the situation where our reports were not representative. My proposal was to supplement these voluntary reports with some objective measures and observations in the field. Men with the ability to estimate production by field inspection came high those days. We would have had to pay as much as $3200 or even $3800 a year, and since I wanted about 5 such men to begin with, my proposal bordered on the fantastic. The Assistant Chief listened with interest, or at least he was polite about it, but his answer was that Agricultural Estimates boys could think up more things to do than there would ever be money to do it with.

Mail Questionnaires Inadequate

Now I mention this, not to imply that I was the only one—or the first one—to recognize the inadequacies of our mail questionnaire techniques. There were many others. In fact, back in 1926, J. B. Shepard had developed a pretty comprehensive plan for an annual sample census of agriculture. That plan blossomed into the so-called Buchanan Bill that never got out of committee. Objective measurements of various kinds have also been used from time to time. But fund limitations have forced us to rely heavily on the very inexpensive uncontrolled mail sampling techniques, which, over a period of time and in average situations, have

proven to be fairly satisfactory. For example, estimates of acreage planted to corn, made on July 1, when compared with the final estimate after correction to the census and other check data have been off by less than two per cent for the last six years, and except for 1951, when the miss was 3½ per cent, the other five years averaged slightly more than 1 per cent. The estimate of acreage of winter wheat seeded on December 1 has been about as good, or even a little better; in fact, I had to go back to 1940 to find one where the deviation was as much as 3.4 per cent. Cotton, July 1 acreage in cultivation, was nearly six per cent off in 1951, and over 5 per cent off in 1949, but the average deviation for 10 years back of that would be about 1¾ per cent. In this connection, it is interesting to note also the comments by the subcommittee investigating the crop and livestock reporting service in 1952. After some rather sharp criticism of some of the techniques the committee remarked, "the most disturbing thing is that the method [the mail sample and the regression technique] seem to work."

I should like to make one other preliminary observation. We are keenly aware of the fact that when one of these large deviations occurs, it is an occasion for great excitement and attracts a great deal of attention. Anyone familiar with sampling knows that even with the best of procedures, we do not have 100 per cent assurance that a large error will never occur. Three principal sources of error are commonly recognized, namely—sampling error, response error, and deviation in the forecast. Thus, a sound program aimed at improvement in the accuracy of estimates should not overlook any of these three sources of error. As a matter of fact, experience has indicated that non-sampling errors can and do often exceed errors arising from the sampling process.

Improvement Needed—Estimates Essential

In Agricultural Estimates we have recognized for a long time the need for improvement. We know that on the average the precision of most of our estimates and forecasts has improved over the years. However, we are very much aware that the accuracy that was satisfactory 10 or 15 years ago is not satisfactory now. On many occasions this has been sharply pointed up by the Chief of the Bureau, the Chairman of the Board, and other members of the staff because we feel keenly the demands that are made upon the statistics.

Let me elaborate just for a moment on a few of these increasing demands. The total list is too long to trouble you with. Originally our crop, livestock, and price estimates were developed for the purpose of giving to the trade, to farmers, and to the public adequate guidance concerning supply and price conditions so that all those interested in the market might have something approximating equal information on

the basis of which to do their individual trading and planning. In more recent years, however, these demands have expanded tremendously. now for example, as you well know, the determination of whether there are to be allotments for major crops depends to a large extent upon the indicated crop prospects. If allotments are determined, then the allocation of total acreage—and mark this—the acreage for individual States and to some extent for individual counties or groups of counties, draws upon the information which we have collected. Again, let us take the price reports as an example. In the early days, price reports and the indexes constructed from them were simply tools for the analysis of price trends and movements. But with the adoption of the parity concept and its later extension as an action tool in connection with price support, these statistics took on an entirely new importance. Consider for a moment the great significance attached to the price report. Take simply the volume of basic crops involved in a support program for a representative period and consider the effect of *just one point change* in the Parity Index upon the parity and support prices of these commodities. If we take the average amount of wheat, corn, and cotton—the really "Big Three" items among the basic commodities—over the period 1948-52, we find that one point change in the Parity Index means a difference of about 5 million dollars in the amount pledged by the government under a support price program for these 3 crops. If we take the single year 1952 we come out with the same or slightly higher figure. This is nearly twice the total appropriation for the entire crop and livestock reporting service which provides acreage, yield, and price estimates for something over 150 crops, not to mention the farm labor and wage statistics.

Consultants Aid Programming, Planning

Before going into a discussion of plans I want to point out that as an aid in planning and programming, the Chief of the Bureau, Mr. Wells, has established a panel of consultants. This panel includes Dr. George M. Kuznets of the Giannini Foundation, Mr. Frederick Stephan of Princeton University, Dr. Walter T. Federer of Cornell University, Dr. T. K. Cowden of Michigan State College, Dr. Earle O. Heady of Iowa State College, Dr. T. R. Timm of Texas A and M College. In addition Mr. Morris Hansen of the Bureau of the Census, Mr. Peyton Stapp, Office of Statistical Standards in the Bureau of the Budget, and the Chief Counsel for the House Agriculture Committee of Congress, Mr. John Heimburger have been invited to sit in with the panel. The plans and proposals I present here are, as the title of my paper indicates, some of the things we in Crop Estimates have been thinking about and are not necessarily the items that will constitute the final program of research which will be followed.

Subject to the foregoing limitations, our plans, stated very briefly, would be to make a thorough-going appraisal of our present methods and conduct tests on an operating level of some of the modern sampling and estimating techniques. This is a long-time objective and must be so because the job is too big and complicated to undertake all in one bite. Our work program, therefore, anticipates tackling some of the more critical problems first and progressing through the whole system.

Sampling Must Consider Speed and Economy

We start with the assumption that speed and economy of operation are essential.

Secondly, we believe our methods should be shifted in the direction of probability sampling—we need more objective methods and methods for which a better basis of evaluating the accuracy of results exists. Our first approach is to consider possibilities of developing mailing lists which are random samples (not necessarily proportionately distributed) and using controlled mail sampling techniques paying proper attention to the non-respondents. Studies of response error and possibilities of a program of objective measurements in the field on the crops before harvest are also candidates for serious consideration. From a long-run point of view, consideration should be given to the role that interview surveys might play as part of the over-all program in terms of obtaining information for which the mail questionnaire is not well adapted and possibilities of improving the accuracy of estimates based upon the mail questions. However, since our funds are limited, it is our judgment that no more than two, possibly three, of the main problems in limited areas should be tackled at a time. For this reason we have set up what we call laboratory States where personnel will be located to carry out the work on a simulated operational basis. The States we have designated are North Carolina, Mississippi, and Texas in the South where the work will be directed primarily toward the solution of some of the problems surrounding the cotton estimates, and Illinois where problems of a more general nature will be explored. In two of these States—North Carolina and Mississippi—we have drawn a probability sample of cotton producers from the 1950 PMA listing. The sample was circularized by mail in early June to obtain cotton acres planted and in cultivation July 1. The mail survey was followed by an interview survey of a sample of non-respondents. During the season some farmers contacted in these surveys will be contacted again to secure information on crop prospects similar to that which is collected under our regular reporting system. Enumerative follow-up of non-respondents will be used in some of these surveys.

At this point I might turn to another plan, or I might say a project

which fits into our over-all plan, which we propose to carry on with the Bureau of the Census this fall. The Bureau of the Census is planning to run a survey in Virginia and Utah as a part of its program in agricultural statistics. This would be approximately a 3 per cent area sample with fairly complete coverage of large farms. It is our proposal to place technical help in those States to work closely with the Census on this project. This experience would be valuable if we should have a sample census at some future time. Even if a sample census does not materialize the experience will be valuable because similar techniques will probably be involved more and more in our regular work.

Plan Study of Yield Estimates at Ames-Raleigh

As many of you may know, the Bureau of Agricultural Economics has, for a good many years, worked cooperatively with statistical laboratories at Ames and at Raleigh. At Ames we have just entered into a contract or agreement for a study of yield estimates. We want to know, for example, what a farmer reports when we ask him the average yield of corn, or wheat, or some other product. How accurately does he know the acreage of a particular field and how closely does he measure the number of bushels which he actually harvests. We need to know more about what a farmer reports, or how he reports, if we are going to do very much in the way of perfecting our over-all estimates. We certainly need to know much more about this question if we are going to do very much in the way of improving our forecasts.

At Raleigh we have a project under way which will go into some of the same types of questions that are tackled in the Ames Laboratory. In Raleigh, however, we have a series of data from a number of experiment stations on the yield of cotton with concurrent weather records. The compilation of these data was arranged for by Dr. Sarle some years ago, but have never been subjected to complete analysis. Work is already begun, and I might say at this point, that the work in the State Statistician's office, mentioned in the previous project, will be correlated closely with the work in the Statistical Laboratory. As a matter of fact, we have assigned a young man to the Raleigh Office to take charge of the field work on the cotton project I mentioned previously, who has had considerable experience in the field of meteorology and I suspect will be used extensively as a consultant in the weather-crop yield study.

In the Illinois office it is our present plan to tackle some of the more general problems that confront us in our estimating work. Our first approach will be to use mailed questionnaire procedures with a random list for general acreage and livestock surveys. In this State we have a very complete current assessors' enumeration which will give us a good basis

upon which to work. One of the most troublesome problems has been to obtain an accurate current measurement of the changes in total number of farms and the changes in the proportion of farms having various kinds of livestock. In tackling this problem it is our current thinking that we will also need to experiment with area sampling techniques to provide estimates of changes in number of farms which will be necessary in States not having an assessor's census. We are hopeful that experimentation in this State will give us the answer to some of the most painful problems we encounter every census year—of adjusting to a new census base.

Bureau Considers Coordination of Research

Now I might say a word or two about the organization of the research development work within the Agricultural Estimates Branch of the Bureau of Agricultural Economics. We are considering establishing in the Bureau a Division in which we will coordinate all research work done in the Agricultural Estimates Branch no matter how or under what funds the work may be conducted. To clarify that last remark I might point out that over a period of a year, research of one kind or another is usually carried on in the Branch. We have certain projects carried on in the States which are provided for under the allotment of funds from the Research and Marketing Act and are matched with State funds. The work on peaches, pears, and grapes for example, in California, is conducted under the Research and Marketing Act funds supplemented by State funds and funds contributed by the industry. This is a definite research project in methodology. This work is being conducted in cooperation with the State Statisticians Office, the California Department of Agriculture and the Giannini Foundation. We have had Mr. Hendricks in consultation with the groups in California on the conduct of the project. Each commodity division and many of the field offices regularly conduct some research on some problem which is bothering them at the time. Such things will all come under the purview of the Research and Development Division. We believe by this method we can better coordinate the entire research program to meet the needs of the whole service. At the Bureau level the focal point will be the Associate Chief of the Bureau, Dr. F. F. Elliott, and myself. We shall also have the services of the Statistical Analyst for the Bureau, Mr. Earl Houseman, as an adviser and consultant.

Planning for a modernized program that has been going on in the Agricultural Estimates Branch for a number of years has been directed mostly toward the technical side of our problem, with a sharp eye all the while toward the workable aspects of the proposals that are made. As I visualize it, our objective is to provide basic data on the agricultural

industry of the United States that will meet the immediate needs of producers, handlers, processors, and distributors of farm products. In addition, the information, after it has served this purpose, must provide analysts, both State and National, with the basic data which they must have if they are to be of the maximum assistance to producers in developing their production plans and furnish the basis for orderly distribution, and to serve those who are responsible for policy decisions.

Accuracy Prime Consideration

Of course, in both cases, the problem of accuracy is of primary importance, but accuracy is, to a considerable extent, a relative matter. The question is, then, how much accuracy is justifiable or necessary considering all of the uses to which the data is put. How much weight shall we give to the time factor? How much to the number of items covered? How much to the refinement of the data, such as the breakdown of production by geographic divisions, or by varieties, or breeds? These questions must be answered, for they have a direct bearing on the statistical techniques that are developed or adopted.

If some 90-odd years of experience means anything at all, it is perfectly evident that agricultural estimates are going to have to improve in timeliness of the reports. This means two things primarily. First, that the reports are going to have to be put out in less than ten days after the first of the month; and second, that once a month is not often enough, particularly in seasons when conditions are changing rapidly. And it seems as though there is never a year when weather conditions in some part of the country are not cutting up enough to make a strong demand for some special types of reports. The precedent has already been established for more frequent reports in the development of the broiler chick reports where weekly issuances are required to permit the industry to handle its marketing and distribution problems adequately. For a long while we did put out 15th-of-the-month reports on truck crops prospects, but that service, small as it was, had to be dropped for lack of funds.

Next, I feel sure that time in its flight is not going to turn back even for one night, and we shall not only have to continue to put out estimates by States, but will be under extreme pressure to go further with the breakdown of the data to counties or areas within the States. This is evident to anyone who has tried to face up to a problem of marketing and distribution. Furthermore, it is evident when we are confronted with a program of crop insurance, of acreage adjustments, with providing farm labor, with meeting the situation that is currently with us in the drought area where the demand is for crop and pasture conditions by counties on a week-to-week basis, and a whole host of other problems.

Finally, we are going to be pressured—in fact we are already being urged—to go a lot further in defining production of crops by kinds, variety, or quality. Feeders have long since recognized that they have to know more about the quality of corn along with the amount that is available. Producers and users of wheat are insistent in their demand that we provide information on the kinds of wheat. It isn't sufficient to put out a figure now on durum wheat. Folks want to know how much amber-durum is being produced. There is nothing new in this development. It dates back a number of years. In 1927 the cotton people recognized the need, and the Cotton Grade, Staple, and Statistics Act was passed and estimates are made of supply of cotton by grade and staple. In our estimates we had recognized that upland and long-staple cotton are two different commodities, but in the marketing of the crop it was found that it is necessary to know much more about the supply in terms of specific grade and staple.

Summary

To summarize then, it is perfectly evident, and seems very clear to me, that in the development of a plan for the improvement of the Agricultural Estimating Service there are three conditions that must be met. Any procedure that may be adopted must be one that can be handled rapidly because timing is one of the primary factors. We are going to have to look forward to putting out a report in less than the ten days that is presently allowed between the time the reporter makes his report to the State office and the release of the report in Washington. Closely associated with the problem of speeding up the issuance is another demand that is gaining in momentum—the desire for mid-month reports. Next, the sampling procedure must provide for State estimates at least, and in many instances be adapted to making district or county breakdowns. And the third factor which must be recognized is the growing need for more specific information by variety, breed, and quality as these factors become more important in the marketing and utilization. There is really a fourth factor—the big question of expense which will most likely be the real controlling factor on any plan. It is around this framework that I feel we must develop our program for improvement.

In our planning from within we have recognized these trends and developments in the demands being placed on our service. The projects which I have outlined fit into the broad objectives and are an approach to a study of the main sources of error or deviations that are most troublesome.

The work on the single crop, cotton, seeks to estabilsh a sound sampling basis for the estimate of the acreage planted or in cultivation. We

have a little more time for this type of inquiry and believe we have good prospects for developing a system using mail inquiry followed by enumeration of nonrespondents that will work economically and with sufficient speed to meet our needs. The work in Utah and Virginia in cooperation with the Census Bureau will provide further experience and knowledge of the limitations and usefulness of small enumerative samples in solving current estimating problems. The projects at Ames and Raleigh are designed to throw some light on the question of response errors while we hope the weather and yield study at Raleigh will indicate ways of improving our forecasting technique.

On the last point I should elaborate briefly. The problem of forecasting error, or we prefer to call it deviation, is one that will always be with us, at least until some way is found to make a reliable long-range weather forecast. Back in the 20's I was particularly interested in this problem. Dr. Sarle did a great deal of work in this field while he was in the Bureau of Agricultural Economics and the Weather Bureau. J. B. Shepard, Fred Waugh, Jack Morgan, and others made contributions to our knowledge in this field. We were all plagued by two problems. The first was the lack of adequate weather records both from the standpoint of the kind of records and the distribution of observation points over the areas with which we were working. The second difficulty was the lack of yield information that was definite and specific enough to meet the needs of such studies.

In closing, I wish to emphasize just one more point. The Agricultural Estimates Branch of BAE has always, at least in the 27 years I have known about it, been much interested in a research program, and I think has done quite a little in spite of the limited resources. May I call attention to a few things that have come from our research. As a part of an evaluation and improvement program concerned with the price estimates made by the Bureau, a contract was entered into in June 1949 with the Institute of Statistics of the University of North Carolina as a Research and Marketing Act project. Under this project, among other things, prices were enumerated for a probability sample of merchants patronized by farmers, for comparisons with the prices collected currently on the usual quarterly mid-month price survey. Prices for 104 items were compared. There were 25 for which the estimates based on mail returns showed a higher price than the enumeration, 72 where the reverse was true, and 7 where there was no difference. Of the 97 cases where the estimates from mail returns differed from the enumeration, the differences were statistically significant in 41 cases and not statistically significant in 56 at the 95 per cent confidence level. Thus, a majority of the differences could easily have arisen merely from fluctuations of random sampling.

Even when the differences were statistically significant, positive and negative deviations were both in evidence, which strongly suggests that the mail return contains no consistent bias. It appears also that no single explanation is adequate to cover all the statistically significant differences between the mail and enumerative surveys, and that case-by-case study is necessary to resolve them. The Institute report questions whether the bias, which seems to be present, is sufficiently large to justify the cost of removing it completely. The report also points out that the existence of bias, if constant, does not seriously detract from the value of the data in indicating trends. However, continuing review of the data collecting process could uncover some of the sources of variation, and lead to their elimination or their reduction.

I might also mention the fact that the Master Sample was developed under a cooperative research project with the laboratory at Ames. The dairy products reports are based upon a scientifically designed sample, as are the more recent broiler reports and some of the cattle on feed reports. There is some very interesting work being done in California on fruits which was reported on at the meeting of the American Statistical Association last winter.

We are very happy over the provision of funds for methodological research in our field. This is the first time, that I know of, when we have had such an opportunity to tackle some of the problems that have occupied our thoughts for a long time.

HOW THE OFFICE OF STATISTICAL STANDARDS CAN HELP DEVELOP A PROGRAM

PEYTON STAPP
Bureau of the Budget

I HAVE been asked by Mr. Walter Hendricks to speak on how the Office of Statistical Standards can help develop a program for better and more economical crop and livestock estimates. Let me preface my remarks with a brief general description of the functions and purposes of the Budget Bureau's Office of Statistical Standards. It is, as most of you know, the successor of the Central Statistical Board established in 1933. The Act creating the Central Statistical Board had as its purpose: "to plan and promote the improvement, development, and coordination of, and the elimination of duplication in, statistical services carried on by . . . the Federal Government. . . ." When the Budget Bureau was reorganized in 1939 to serve as the staff arm of the President, the Central Statistical Board and these functions were transferred to it.

Budget Bureau Assists President

A few words on the Budget Bureau itself may even be appropriate. The most fundamental function of the Bureau is the preparation for the President, of the Annual Budget of the United States Government. Involved in this process is the determination of the program of the Government. Programs which are to be carried out have appropriation requests made for them; activities which are not to be recommended by the President do not have such requests included. The amounts requested represent a level of activity recommended. I digress to state the obvious because it is obscure to many. The Budget reflects the Administration's programs, and the Budget cannot be thought of separately from the programs which are desired.

But under the concept underlying the 1939 reorganization the Bureau has other functions as well, which were deemed essential in helping the President carry out his duties as the Chief Executive of all Government activities.

Executive Order 8248, of September 8, 1939, sets forth the functions of the Bureau of the Budget as follows:

"1. To assist the President in the preparation of the Budget and the formulation of the fiscal program of the Government.
"2. To supervise and control the administration of the Budget.
"3. To conduct research in the development of improved plans of administrative management, and to advise the executive departments and agencies of the Government with respect to improved administrative organization and practice.

"4. To aid the President to bring about more efficient and economical conduct of Government service.
"5. To assist the President by clearing and coordinating departmental advice on proposed legislation and by making recommendations as to Presidential action on legislative enactments, in accordance with past practice.
"6. To assist in the consideration and clearance and, where necessary, in the preparation of proposed Executive orders and proclamations, in accordance with the provisions of Executive Order 7298 of February 18, 1936 (superseded by Executive Order 10006 of October 9, 1948).
"7. To plan and promote the improvement, development, and coordination of Federal and other statistical services.
"8. To keep the President informed of the progress of activities by agencies of the Government with respect to work proposed, work actually initiated, and work completed, together with the relative timing of work between the several agencies of the Government; all to the end that the work programs of the several agencies of the executive branch of the Government may be coordinated and that the moneys appropriated by the Congress may be expended in the most economical manner possible with the least possible overlapping and duplication of effort."

Bureau Services Varied, Important

It is with number 7 that the Office of Statistical Standards is most directly concerned, and from which our most direct interest in crop and livestock estimates arise, although certain other functions are also involved. Our starting point is the program of the President— it is part of that program that estimates of crop and livestock production be made accurately and promptly. It is our concern that adequate statistical standards and methodology be adhered to in the collection, computation, and publication of such estimates. And it is our concern that such estimates be prepared as efficiently and economically as possible—efficient in the expenditure of funds and man-hours and also in minimizing the reporting burden on the public.

These are concerns which we share with the Bureau of Agricultural Economics. We have confidence that Mr. Wells, Mr. Newell, and the staff involved in Washington and throughout the States are also concerned with good methodology, accurate statistics, and careful expenditure of Government funds and farmers' time. What, then, can we contribute to improving this service?

We consider ourselves competent economists and statisticians. But we do not believe we are more competent than economists and statisticians in the Bureau of Agricultural Economics and available to it. Perhaps we make some contribution by serving as a second head. While I think this is frequently the case and some benefits flow from it we could not justify our participation on this ground alone.

Coordination

Much of what we do in the Office of Statistical Standards involves coordination. We conceive of all Government statistics as parts of a unified system—scattered, it is true, throughout the Government departments, but all to be fitted together as consistent parts. The statistical system of the Government is in fact largely made up of separate pieces developed to serve isolated needs, which by our efforts at coordination also serve a broader purpose. Our main drive is to perfect this system which is now far from perfect—there are many gaps in our statistical picture of the economy, there are many pieces which do not fit well together. I will mention our two retail price series, the Bureau of Labor Statistics Consumer Price Index and the Bureau of Agricultural Economics Prices Paid by Farmers, as an example where the series are not directly comparable or capable of being combined for a total retail price index. There are many facets of this coordinating activity—improving operating or administrative reports so they will supply economic data is another.

But I do not believe the crop and livestock estimates fall in the problem areas where coordination with other series is a major issue, although I shall mention later a need for better coordination among States.

Examination

Another function of the Office of Statistical Standards involves careful examination of respondents' burdens. And to the business world we have made a great contribution by reducing the burden of replying to Government questionnaires. To this task we definitely bring superior knowledge. We have reviewed tens of thousands of questionnaires; we have talked with thousands of businessmen, accountants, controllers, and others as to how their records are set up; we have learned what types of questions will get useful results, what types of inquiries can be tabulated to supply answers to the questions in the administrator's mind.

There are problems of questionnaire design involved in the crop and livestock reports. The Bureau of Agricultural Economics statisticians are aware of these problems and informed on them, but I believe that we are more sensitive to the difficulties involved and that we make a contribution here. Review of reporting forms is one of our major tools for improvement of data but it is also one of the most controversial. The sad truth is that economists and statisticians are careless in drawing up questionnaires. You can also be very touchy about your craftsmanship in this regard. We have seen too many surveys fail because of poorly drawn questionnaires to be modest about our responsibilities in this respect. We carry out our activities in this respect largely by review of the schedules, but our participation in the early stages of the development

of a new program is extremely useful to us and useful to the Bureau of Agricultural Economics. It is useful to the BAE for a number of reasons—perhaps the most compelling of which is, that if we are going to insist on changes in questionnaires it is easier to make them at early stages than after the program has been developed. The questionnaire aspect of the program is a technical problem. We emphasize this part but I would not like for you to carry away the impression it is an end in itself. Our responsibility is for better statistics and greater efficiency and questionnaire format is only part of the problem.

To recapitulate up to this point: We are concerned with the development of new and better methods of estimating acreage planted in crops, expected yields, and production because it is our statutory responsibility to concern ourselves with the problem. The crop and livestock estimates are one of the dozen most important and most expensive statistical activities in the Federal Government and we have no choice. These estimates are of direct interest to many others than farmers: bankers, railroads, manufacturers, even circuses guide their operations by these statistics. With our responsibilities in connection with the budget justification, the adherence to statistical standards, the adoption and improvement of economical methods, and a careful and critical review of the means of asking for the information needed, our participation is part of the governmental process.

But our final and greatest contribution arises out of the institutional factor that we are separate from the actual operations and can in part be the conscience of the activity. The Government has no more important purpose than the collection and dissemination of information on the basic social and economic conditions and changes in these conditions throughout the country. Possession of facts about the general welfare is a requirement for sound policies. We economists and statisticians frequently feel that legislators and administrators fail to appreciate the connection between the statistical programs of the Government and the information they need for operations and for background. As economists we may go further and feel that even when they support statistics as bare fact gathering they fail to appreciate the need for analysis and study of hidden relationships beyond the obvious direct measurements. But our office, first as an independent agency responsible to the President, and since 1939 in the Budget Bureau representing one of the explicit functions outlined to serve the President in the broadest and most fundamental aspects of Government, is evidence of top level recognition of the importance of these statistical activities. So I repeat, we have a job to do, as a conscience, in continually keeping on pressure for high standards against the claims of expediency.

I should stress that I am not talking of integrity but rather of cutting corners because of practical considerations. And I repeat, this is an institutional influence—the same forces would be involved if the individuals now in BAE were in the Bureau of the Budget and we were in BAE. We are not oblivious of the fact that there are deadlines to be met, that there is inertia resisting change, that first-rate personnel is scarce and can work on only so many problems at one time, that it is human nature to do the routine and to put off really hard thinking. But it is part of our job to push against these facts of life just a little more than the administrator does and we can do it because we do not have the immediate responsibility for handling the budget, the personnel problems, the public relations and the hundred other things which interfere with concentration on the best possible technical job.

These are some of the things we expect to contribute to the revision of techniques in the crop and livestock estimates.

Summary of Efforts

It is a fair question to ask what we have done on this problem in the past. For a number of years we have been urging research into better methods of making estimates, being convinced that the system of shot-gun scattering of questionnaires with a high rate of nonresponse and somewhat ambiguous subjective appraisals for answers had in it unknown possibilities for error. And we recognize that the crop and livestock estimates are significant statistics—significant decisions affecting farmers' welfare and the national welfare are made from them. Therefore we urged study of new methods which were practical to apply and which would decrease the possibility of sour estimates. Here is our role of conscience. The system now in use is a large cumbersome system, relatively inexpensive (though not necessarily efficient) which seemed to work adequately. For practical men there is a strong pressure not to tamper with such conditions. The unlucky cotton estimate of 1951 demonstrated the weakness, created public concern and congressional willingness to support efforts toward improvement. (Parenthetically, I might say this was not the first or only case of estimates far off the later realization.) All of these conditions of public concern were probably necessary before very searching study and critical appraisal of present methods and active plans for changing these methods could be started. I hope our previous efforts have helped to create an atmosphere leading to more thoroughgoing study than might have been the case otherwise.

Most of our direct efforts have been applied to review of the questionnaires. Many of you know that this system involves a very large number of forms. There are some 300 basic schedules with as many as 22 regional

variations in general crop schedules in a single month. Let me digress to say categorically that we are not opposed to State individuality and are sympathetic to the idea of a State getting data for analysis of its own problems. We insist, however, that the objective of the system is a good national set of estimates, and from the Federal Government's point of view, State differences and State needs should not be allowed to jeopardize this objective. We believe the BAE has been too tolerant of State idiosyncrasies but under our prodding steps are being taken for better coordination of State procedures.

Here, as in some other parts of the improvement program, we have and will come in conflict with the interests of some of you. I do not want you to think we have a preconceived plan to impose. We will not forget and you should understand that the Office of Statistical Standards does not have the responsibility for developing a better program for crop and livestock estimates. That is the responsibility of the Bureau of Agricultural Economics. But we have a review function in the Bureau of the Budget with respect to the statistics and the budget which is an inherent part of the process. It is not too much, I think, to ask for your understanding of our point of view that good national estimates should not be jeopardized by diverting resources needed for this end. Once adequate national estimates are available, further extension can be dealt with intelligently as a policy matter.

These are general observations. They suggest nothing revolutionary nothing startling. And that is the correct impression. You are too mature and too sophisticated to expect that one group of competent professional people can bring anything startling to bear on a problem being worked on by another group of competent people. It is a matter of degree, of emphasis, and of objectives.

Future of Estimates

In a few concluding remarks let me be a little more specific and touch on some controversial subjects. The BAE prepares estimates on 136 general crops through a State system which permits State estimates as well as a national estimate. Many of these national estimates are not accurate enough and a program to improve the estimates is underway. This situation leads to a few key questions. In stating the questions I do not express a judgment on the answers, but we are going to insist that each of these questions be explored. My chief reason for coming to Corvallis is not to make a speech but to take advantage of this opportunity to talk with as many of you as possible about them because I believe there will at first be wide differences of opinion as to the right answers.

Starting from the present level of appropriations—for fiscal year 1954 almost $2,500,000 will be spent for crop and livestock estimates—the questions I have in mind are:

1. Can new methods and techniques be used which will yield sufficiently accurate results for the present program at the present cost? If not, there are three choices and one of these, to continue the present system at the present cost, has been eliminated. The Administration, the Congress and the Department of Agriculture have decided that better estimates are needed.

A second choice would be to apply the techniques and methods necessary to get the accuracy needed for all parts of the present program and carry it out at whatever it costs.

The third choice is the most difficult operation to face an administrator: To set priorities, carry out the more important ones and drop the least important ones. There seems to be something sacred about a going program. We all do without many things we need without complaining but once we have them deprivation hurts more than the absence of something more important.

2. What accuracy do we need in national estimates? And what do different degrees of accuracy cost? Accuracy comes high in large statistical projects and the reduction of a sampling error to 1 per cent costs much more than its reduction to 2 per cent. We probably do not need the same accuracy for all crops. Speed also comes high but I think no one would suggest slowing down the estimates.

3. What will State estimates cost? Implied in this question are many degrees of choice: We could have only national estimates, State estimates for final yield but only national estimates for prospective yield, State estimates for the more important States but not for all, and others. The final decision is a policy decision—the Department of Agriculture will have to draw up and support a program, the Budget Bureau will have to review it and recommend a program, and the Congress will finally decide what appropriation is made. But we can and must explore the costs and implications of various combinations so that an intelligent decision can be made.

4. What crops can we afford to cover? Otherwise rational men react strangely to my just framing this question. It is only because I am a stranger to most of you that I dare raise it here.

There will be opposition to the kind of review of the program I suggest but it is simply the economic problem of allocation of resources. If statistics were free goods we would not have to choose. As it is, however, accuracy of national estimates, the number of crops covered, and State estimates all stand in competition with each other for the budget dollar.

The Budget Bureau by being a review agency can be more adamant in withstanding individual pressures than if it were directly involved in formulating the program.

The original hypothesis of the present level of appropriations is only a simplifying assumption. Future appropriations may be higher or lower. What I am trying to say is, the Office of Statistical Standards is going to insist on answers to these questions and to insist that improvements not be limited only to the extent that larger appropriations make possible.

A DISCUSSION FROM THE VIEWPOINT OF A STATE AGRICULTURAL STATISTICIAN

ROY A. BODIN

Minnesota State-Federal Crop and Livestock Reporting Service

The papers by Mr. Newell and Mr. Stapp contain much subject matter of vital concern to all who have an interest in crop and livestock estimates, particularly as concerns the future. I have been invited to discuss their papers and to present observations on the topic for this session from the viewpoint of my operating position. In taking advantage of this opportunity, it is my desire to arrange my comments into thought areas as follows:

(a) Background as related to development of the current program.
(b) Consideration of present and future objectives.
(c) Need for and some problems associated with attaining flexibility in the program.
(d) Benefits derived from State-Federal cooperation.
(e) Source and type of information.
(f) Focal points for improvement.

Background As Related To Development Of Current Program

The subject of improvement in the field of agricultural estimates is not new. The problem of meeting the continually growing need for more timely, accurate, and detailed information has been a live topic for discussion and action in all of the 25 years that it has been my privilege to have an active part in processing the program of the Crop Reporting Board. Furthermore, the historical records of the Department are evidence that its employees before my time were concerned with this same type of need, but for use in a much less commercialized type of economy. If this had not been the case throughout the years since the beginning of this work in 1862, the current program would be non-existent or completely unworkable for lack of a trained organization with the know-how for getting the job done in a manner consistent with objectives prescribed by legal requirements and funds allotted for the purpose. It is not the intent to imply in any way that the need for further improvement in both scope and methods is being ruled out. In reality, the estimating program should be more flexible to permit recognition of new needs, some of which are very local in scope, while drawing on research and experience to provide the most efficient methods and effective tools for carrying it out.

Consideration Of Present and Future Objectives

It seems, to the writer, very essential to carefully examine the objectives of the present and any proposed programs when considering improvements in current procedures or before substituting new ones. This should include a re-examination of the goals of the present estimating program for the nation, region, state and county. Conclusions, as to their validity, should be reached only after close scrutiny of present methods and consideration of all criticisms and suggestions pertaining to results and needs. This means, too, the consideration of the hard facts of life as revealed by practical experience in which sampling theories and ideas have been tested in terms of performance and check information. It is my observation that considerable criticism has been directed at the Crop Reporting Service by critics who apparently were not familiar with or did not wish to recognize legal and other restrictions as related to the activities of the Crop Reporting Board. In other words, the objectives for any proposed program should take into account all legal requirements and they must be realistic in terms of experience and available funds.

Need For Flexibility

In regard to the need for flexibility in the program, I am thinking especially of subjects of major importance in local areas, and some times nationally, for which there is no program or one which is grossly inadequate. Turkeys are an example and one with which I have had much first hand experience in Minnesota. For the nation there has been, and still is, a serious need and demand for more comprehensive information on the production of poults by hatcheries, number of turkeys being raised by breed, and related subjects. In Minnesota the need was recognized locally in 1949 when State funds were provided and matched on a 50-50 basis with Federal funds available under Title II of the Agricultural Marketing Act of 1946. Even though funds were available, we were unable to launch the program promptly for two primary reasons. (1) Inability to find employees with sufficient training willing to accept the established salary and (2) problems and delays related to gaining schedule clearance. The first problem had to be worked out at the State level because funds allocated under Title II are expendable under regulations prescribed by the State. The second reason is purely Federal in nature due to the requirement of the Reporting Act. This regulation requires Budget Bureau Clearance of any form used in soliciting information from 10 or more persons or establishments whenever federally appropriated monies are involved. I cite these problems at this point merely as a partial answer to a very frequently asked question, "Why don't you or the Crop Reporting Board do thus and so?" Our efficiency and usefulness is often seriously impaired because we cannot act quickly and in a manner consistent with the current situation.

Benefits Derived From State-Federal Cooperation

It is my belief that a blueprint for improving crop and livestock estimates should include provision for greater service at the state and county level. Often there seems to be a tendency, on the part of many, to overemphasize the significance of the national totals and minimize the need for area, state and county data. This is particularly noticeable for commodities having a wide geographic distribution. For many crop items there are significant differences between areas in development, time of harvest, marketing and related subjects. These dif-

ferences are also often important within state boundaries. Many persons and agencies are deeply interested in these variations because of direct concern in rendering service related to processing, storing, transportation and other phases of agricultural marketing. My experience in Minnesota has been that there is an ever increasing interest on the part of farmers, farm organizations, Federal and State governmental agencies, processors and handlers of agricultural products, consumers and others for more and more detailed information about the State's Agriculture, even down to the township level. This type of demand should not be ignored, particularly when many states, including Minnesota, make very substantial contributions towards maintaining the Crop Reporting Service on a co-operative basis with the Federal government. The work at the state level is strengthened by such cooperation through the provision of more adequate facilities and additional sources of information. In Minnesota, for example, the Federal government, through cooperation with the State, has access to the results of the annual Agricultural Census as taken by local assessors in May and this is of undeniable benefit to the Agricultural Estimates program. The State annual census has provided a reliable measure for such subjects as the change in numbers of farms, and number of farms producing certain commodities. It has also furnished information on land use and key livestock items more accurately than any other proven means. Furthermore, there is the great advantage that the annual State census data not only strengthen the estimates for the State but they also provide a sound basis for county estimates. It is perhaps well to remind ourselves that estimates by counties are now a "must" under several phases of the Federal farm program. This fact often becomes obscured when discussion occurs regarding whether specific projects are local in nature and, therefore, the sole responsibility of the state or local agencies. I shudder when I think of the critical position that the Agricultural Estimates program would be in should cooperative agencies at the state level withdraw their contributions. The National estimates would be seriously affected and certainly the adequacy of estimates for most states would deteriorate.

Source and Type of Information

At this point I wish to stress that there are two types of information, the tangible and intangible kinds. Many business concerns, particularly the larger ones, usually have very specific records and the problem is simply one of gaining their cooperation and providing them with a reporting form which is consistent with their accounting procedures. In the case of smaller concerns, however, it is my observation that they tend to have less adequate records especially on a current basis. For such firms, it is often necessary to accept estimates rather than data from actual records. An owner of a small hatchery, for instance, is frequently in a position during the busy season of not having complete current records due to the fact that he is often the operator, salesman, and bookkeeper.

Farmers also fall in the class of those whose records are often non-existent or are mental recollections. Because of this, I am inclined to group much of the information from farmers as of the intangible type. To illustrate, the farmer usually knows how many cows he has or about how many hens. He can usually provide reasonably accurate land use data. Such information has a rather tangible basis. He is, however, at a distinct disadvantage as are the rest of us when we ask him about crop production prospects when his crop is emerging

from the ground or at any time before actual harvest. Of course, the evidence of production becomes increasingly tangible as harvest time approaches. Once the farmer has harvested his crop he is then in a position, if he chooses, to report his production. Even then, when he reports, he may do so on the basis of combine measure or other rough approximation rather than exact measurement. He may do so on the basis of gross or net weight; that is, dockage included or dockage out. Schedule design and careful sampling procedure are means for minimizing some of these problems, but my experience keeps whispering in my ear that it is quite unlikely that such measures will be the means of eliminating all of the uncertainties associated with estimating prospective production prior to harvest. Neither do I expect that such measures will completely correct biases which creep into raw data as a result of human reaction to unusual conditions, particularly factors such as acreage allotments, loan programs, or price adjustments.

Focal Points For Improvement

As to procedure, I am afraid my remarks will be disappointing. I have already mentioned the need for careful outlining of objectives. For me, it seems rather useless to discuss methods if we are to be concerned only with a procedure designed to provide a national estimate without regard to sub-estimates for regions, states or smaller areas. I do not believe that to be our goal nor should it be even though it might greatly simplify our problems, reduce our operating costs and lessen the chance for criticism. Admittedly, there are some statistical universes for which only national totals are significant, the same is true for states, but in most instances it is a practical possibility to subdivide the national totals so that the information of sufficient reliability on a state and county basis is available for use by the largest possible number of persons. Assuming that estimates by states and frequently for counties are a desirable feature, then our planning must have in view the strengthening of procedures at the state level. This would mean more adequate facilities to permit development of additional sources of both new and check type information, more complete investigation of the universes to be sampled, more thorough analysis of returns, stratification of the universe for each commodity into sections which are homogeneous and suitable for the application of sampling procedures, and enumeration of the parts that are not. We have had first hand experience to realize the benefits from the latter approach, particularly in the handling of grain stocks reports, hatchery data and other subjects in which operations differ widely as to size and are often highly specialized. Another extremely important phase of the improvement program should be the strengthening of the educational aspects of this work through agencies such as the Extension Service, farm organizations, industry groups and others. Much work needs to be done to encourage those in possession of needed information to make it available. I believe we would be guilty of gross neglect were we to overlook the importance of the educational phase for improving the estimates and instead concern ourselves largely with problems relating to the more technical features such as questionnaire design and sampling procedure. I sense, too, rather frequently, the need for a closer working relationship between those who interpret and use the estimates and those who have worked closely with the raw data during the collection process. This could be a safe guard against the tendency to use data for purposes not intended.

DISCUSSION

LYLE D. CALVIN
Oregon State College

I should like to thank Mr. Newell and Mr. Stapp for their informative papers. This has been an interesting experience for me, not as an economist but as an experiment station statistician, to find out what the Office of Statistical Standards and the Bureau of Agricultural Economics are considering in order to improve agricultural estimates.

The Institute of Statistics of North Carolina State College has participated in the research of the BAE for the past ten or twelve years. One of the projects was the study on prices which Mr. Newell has described. The amount of research has been rather small, and the problems undertaken have been directed mainly at minor improvements in the techniques now used by the Division of Crop and Livestock Estimates. There has been no attempt to explore entirely new approaches or to seriously evaluate those in use. Several years ago, the Institute outlined to the BAE some research ideas which they thought a statistical unit could do to help improve methods. At that time the ideas were turned down because of lack of funds. If more funds are to be available or a heavier research program is contemplated, then it is hoped that some of the projects will have as their objectives the study and evaluation of new methods and, what may be even more important, a serious evaluation of present procedures. Mr. Newell has not mentioned specific projects for the future, probably from lack of time.

Disagreement Concerning State-Local Estimates

One fundamental point on which the two speakers seem in disagreement is in regard to state and local estimates. Although one objective of the system of crop and livestock estimates may be a good *national* set of estimates, this can hardly be the sole objective. State differences and state needs must be considered and allowed for in any set of estimates put out. Mr. Newell has pointed out that there is extreme pressure to have added breakdown of estimates to counties or areas within the states. With the present decentralization ideas, this is especially so. The estimates are, after all, not a concern of the United States Department of Agriculture and Budget Bureau alone; they also involve many state agencies and relationships between state and federal agencies. Also, when allocations of acreage are based on state estimates and sometimes even on county estimates, the breakdowns are of vital importance.

The problem of dropping individual crop or livestock estimates seems a more pertinent one; however, even here terrific pressure will be met. As crops change with time and demand, it is inevitable that some items will no longer warrant the time and expense involved in collecting and dispensing their estimates. It is not and will not be an easy job for the Office of Statistical Standards or the BAE to recommend dropping an item in the face of complaints of discrimination, selectivity, etc.

It was a pleasure to hear Mr. Stapp emphasize the importance of good questionnaires. Anyone who has reviewed more than a few questionnaires quickly comes to the conclusion that many questionnaires, whether drawn up by economists, statisticians, or any group, fail to give unbiased answers to the questions for which they were designed. Too frequently no criticism is ever

made of these questionnaires, because the analysis stage is reached before it is realized how poor the questionnaire is. With experience such as the Office of Statistical Standards has, their review of questionnaires should be of great aid; however, even here there must be many unanswered questions of form, procedure and evaluation that a good research program could help answer. It is unlikely that all the methods presently used are the best possible, or even as good as desired. Perhaps the Office of Statistical Standards might help promote needed research on questionnaires.

Accuracy Has Many Meanings

The question of accuracy has been brought up by both speakers. As with many words in common usage, "accuracy" has more than one meaning. Perhaps it would be worth while to consider the different meanings and the importance of each. Mr. Newell mentioned three sources of error, sampling error, response error, and forecast error. Accuracy can be defined in terms of a low error of any one or all three of these types. The statistician prefers to call sampling error a measure of *precision* and response error a measure of *accuracy,* while forecast error can result from a number of causes. To further distinguish between these definitions, precision is concerned with the deviations among samples, and accuracy is concerned with the deviations of the samples from the "true" value. For instance, the precision with a particular sampling method may be very high (low sampling error) but the accuracy be low because each response is, say ten per cent, below the true value.

The errors of prediction, or forecast error, have a number of sources. They are (i) sampling error, (ii) response error, (iii) error in system of predicting, and (iv) extrapolation error, which is closely allied with (iii). One or more of these errors may be operating for any forecast.

Sampling error can usually be fairly easily estimated. The sampling design and amount of sampling will directly affect it. This error is constantly with us, and, except in rare instances, no research should be necessary to estimate it. Response error, on the other hand, can seldom be estimated without research. A method has been developed in the case of non-respondents to adjust for the bias, or response error. The BAE is using this method at the present time, I believe, and would like to increase its use. Much of the work on response error must be done by evaluating present procedures, which will come under the research program. Response error can also be affected by the sampling design, although to what degree can seldom be ascertained without an objective investigation in the field.

The question of accuracy can be answered then only by confining ourselves to a particular definition of accuracy. The usual procedure, except when forecasts are desired, is to either decrease response error by proper design, adjust for it by one of several methods, or ignore it, and then to consider only sampling error when speaking of accuracy.

Although it may be inadvisable to put out sampling errors along with the crop and livestock estimates, they should certainly be known to the BAE and available to Congress. Would it be feasible to present costs for different degrees of accuracy and put the issue squarely up to Congress? An indication might be given of how much could be saved by omitting certain items and what the possible loss would be due to low accuracy or to omitting items. This should certainly take some of the political pressure off the BAE, although at the same time it may also decrease their freedom of activity. Perhaps it would be worth it.

CRITICAL REVIEW OF DEMAND STUDIES

Chairman: R. E. L. Greene, University of Florida

MEASUREMENT OF MARKET DEMAND WITH PARTICULAR REFERENCE TO CONSUMER DEMAND FOR FOOD

G. M. KUZNETS
University of California

RESEARCH in empirical demand measurement may be examined from several points of view. Since applied demand studies are attempts at statistical measurement, emphasis in a critical survey of this area may be placed on the process of measurement itself, on questions of method and technique. Alternatively, one may assess the consistency of the formulation employed in a particular study and its congruence with the existing body of theory. From a more practical point of view, one may inquire into how sensible the end results of the study are, how consistent with other information that might be available for the commodity or group of commodities, and how good a basis for prediction is provided. These are not mutually exclusive modes of appraisal, and there is some of each in this paper. The primary emphasis, however, is given to problems of measurement. Much of the paper deals with statistical and quasi-statistical questions; these appear to me to be central to an area of work in which the main concern, after all, is the measurement of parameters of a set of relations.

Part I provides a frame of reference for the discussion of statistical measurements; rival formulations are described and some preferences expressed without attempting to adjudicate. Part II reviews a number of studies, published and unpublished, dealing with the measurement of demand for food as a whole and for some items of food. The paper concludes, Part III, with brief remarks on promising directions of research.

Frame of Reference and Rival Formulations

Most of the procedures employed in demand studies utilizing time series data are derivable from the following measurement model (a complete set of G linear equations)

$$\text{(I)} \qquad B(y_t' - \varepsilon_t') + \Gamma(x_t' - \delta_t') = u_t'$$

The variables constrained by these equations consist of:

(i) G dependent variables η, y_t' is the (column) vector of observed values of η_t at time t.

(ii) K explanatory variables ξ, including lagged dependent variables; x_t' is the (column) vector of observed values of ξ_t at time t.

(iii) G + K residual variables ε and δ representing errors of measurement; ε_t' and δ_t' are (column) vectors of observational errors at time t.
(iv) G residual variables U representing the joint effects of neglected explanatory variables, u_t' is the (column) vector of realized, but unobservable disturbances at time t.

B and Γ are matrices of parameters that are to be estimated; it is ordinarily assumed that B has inverse. The specification is completed by adding the condition that there exists a joint distribution function of ξ, ε, δ, and U. In general, the disturbances U are posited to be independent of ξ, and the errors ε and δ to be independent of η and ξ, and possibly also of U.

Economic considerations determine the selection of η and ξ and justify their inclusion in the model. The presence of random vectors ε, δ, and U in (I) makes the measurement model statistical and the measurement of parameters B and Γ a statistical problem. The compunction to introduce these variables does not come from economic theory as it is generally formulated (nor from other economic considerations) but appears to be generated by the measurement problem itself.[1] In consequence, the specification of the residual variables is from an economic point of view permissive and formal, i.e., devoid of economic content. This appears to be true of the conditions on the residual variables already stated, and also of the following assumptions ordinarily imposed. (a) The distribution of the residual variables λ_h ($\lambda_h = \varepsilon, \delta$, U) is normal with fixed parameter matrices ($0, \Sigma_h$), (b) λ_{ht} is independent of λ_{hs}, $s \neq t$.

Model (I) has been specialized in alternative ways to facilitate estimation;

1. *The Error Model.* The disturbance vector u_t is omitted, implying that all of the explanatory variables are recognized explicitly in the model. In this version the distinction between dependent and explanatory variables appears to have little significance. The error model can be written as:

[1] Marschak remarks that "Too often economic theory is formulated in terms of exact relations (similar to alleged laws of natural science), with the frustrating consequence that it is always contradicted by facts. If the numerous causes that cannot be accounted for separately are appropriately accounted for in their joint effects as random disturbances or as measurement errors, statistical prediction in a well-defined sense becames possible." Jacob Marschak. "Economic Measurements for Policy and Prediction," Chapter I in *Studies in Econometric Method.* Cowles Commission Monograph 14, Wiley, 1953, p. 14. In the same vein, one could argue that if residual variables are just tacked on to the theoretical models, one faces the possibility that theoretical formulations may never be contradicted by facts. It seems to me that the theoretical formulation or substantive considerations must place some constraints on the residual terms; the ex post statistical specification of the latter appears to be largely a matter of expediency.

(1) $$By_t' + \Gamma x_t' = B\varepsilon_t' + \Gamma\delta_t' = v_t'$$

2. *The Shock Model.* Conversely, errors of measurement are deemed negligible and are disregarded. Model (I) then becomes:

(2) $$By_t' + \Gamma x_t' = u_t'$$

Statistically, the difference between (1) and (2) is that in (1) both X and Y are dependent on V, while in (2) U is independent of X, but not of Y. The shock model can be given a more general form which recognizes errors of measurement in the dependent variables:

(2a) $$By_t' + \Gamma x_t' = u_t' + B\varepsilon_t'$$

3. *The Recursive Shock Model.* Matrix B is triangular permitting a recursive solution for the dependent variables. In each equation the disturbance U is assumed to be independent of the dependent variables that have appeared in the preceding equations of the system.

Estimation. We turn now to a brief consideration of estimation methods in connection with each of the specialized models.

(a) Maximum likelihood estimates of B and Γ in the error model are possible apparently only if the variance-covariance matrix of errors, $\Sigma_{\varepsilon,\delta}$, is known in advance. Methods yielding consistent, but inefficient estimates not depending on prior knowledge of error parameters were discussed by Wald[2] and Geary[3] but have not been employed in demand analysis. Tintner[4] proposed using error variances estimated by the variate difference method as if given in advance to derive maximum likelihood estimates of B and Γ from the same data and used this procedure in the studies cited in this paper. The statistical properties of estimates derived in this manner are not known. If the errors in the variables are uncorrelated, classical regression estimates of the coefficients are asymptotically biased toward zero; if the errors are correlated, the direction of the bias cannot be inferred without additional information. Berkson[5] has indicated in the case of a single equation that if all but one variable in the set are controlled, the regression of the free variable on the controlled will yield

[2] A. Wald. "The fitting of straight lines if both variables are subject to error." *Ann. Math. Stat. 11:* 284-300, September, 1940.

[3] R. C. Geary, "Determination of linear relations between systematic parts of variables with errors of observation the variances of which are unknown." *Econometrica 17:* 30-58, January, 1949.

[4] Gerhard Tintner, "An application of the variate difference method to multiple regression." *Econometrica 12:* 97-113, April, 1944.

[5] Joseph Berkson, "Are there two regressions?" *Jour. Amer. Stat. Assoc. 45:* 164-180, June, 1950. A clarifying interpretation of this position is given by D. V. Lindley, "Estimation of a functional relationship." *Biometrika 40:* 47-49, June, 1953. The case of the nonlinear relation is treated by R. C. Geary, "Non-linear functional relationship between two variables when one variable is controlled." *Jour. Amer. Stat. Assoc. 48:* 94-103, March, 1953.

unbiased estimates even if all variables were observed with error. This is analogous to treating x_t' in (1) as a vector of fixed quantities.

(b) Detailed accounts of estimation procedures suitable for the shock model are available in the literature,[6] the reader is referred to these for description of methods. The tabulation below lists the statistical properties of estimates obtained by methods commonly used in applied studies based on the shock model. A terminological remark may be in order. By reduced form estimates are meant here the indirect least squares solutions for coefficients of an equation that is exactly identified. The limited information method provides maximum likelihood estimates of the coefficients of an overidentified equation which takes into account only the restrictions pertaining to the equation in question. Direct least squares estimates of the coefficients of an equation containing more than one dependent variable are asymptotically biased. Numerical examples indicate that the bias may be relatively large.[7]

Number of dependent variables G	Set of explanatory variables	Identification status of equation	Method of estimation	Properties of estimates
$G=1$	Does not contain lagged dependent variable	Identified	Maximum likelihood least squares	Unbiased, minimum variance
$G=1$	Contains lagged dependent variable	Identified	Maximum likelihood least squares	Consistent and efficient
$G>1$	Contains lagged dependent variables	Exactly identified	Reduced form	Consistent and efficient
$G>1$	Contains lagged dependent variables	Over-identified	Limited information	Consistent and efficient in comparison with other estimates using the same or less information

(c) In the recursive shock model, the condition that in each equation the disturbance is independent of all but one of the dependent variables permits maximum likelihood (least squares) estimation of each equation singly. The resulting estimates are apparently consistent and efficient provided that all of the other assumptions stated earlier regarding the disturbance terms are satisfied.

[6] In particular, Tjalling C. Koopmans and Wm. C. Hood, "The Estimation of Simultaneous Linear Economic Relationships." Chapter VI, pp. 112-199 in *Studies in Econometric Method.* Cowles Commission Monograph 14, Wiley, 1953.

[7] Jean Bronfenbrenner, "Sources and Size of Least Squares Bias in a Two-Equation Model." Chapter IX, 221-235 in Monograph 14, *op. cit.*

Table 1. Demand and Income Elasticities for Food and Selected Livestock Food Products in the United States

Commodity and study	Period	Retail level			Farm level	
		Price	Income		Price	Income
			Current	Lagged		
Food:						
Girshick-Haavelmo[a]	1922–1941					
Limited information		−0.25	0.24	0.05	−0.08	
Least squares (1)		−0.34	0.27	0.06		
(1a)		−0.53	0.33	0.07		
(2)		−0.37	0.28	0.05		
(2a)		−0.56	0.34	0.05		
(3)		−0.32	0.26	0.01		
(3a)		−0.61	0.37	0.02		
Shores[b]	1922–1941					
Limited information		−0.36	0.04	0.44	−0.22	
Burk[c]	1922–1941					
Least squares (1)		−0.20	0.24			
(1a)		−0.29	0.30			
Cochrane[d]						
Least squares (1)	1922–1941	−0.41				
(2)	1929–1942, 1947–1949	−0.24				
Duesenberry-Kistin[e]	1918–1947					
Least squares		−0.81				
Tobin[f]	1913–1941					
Least squares (1)		−0.53	0.45	0.11		
(2)		−0.28	0.27			
Food livestock products:						
Fox[g]	1922–1941					
Least squares (1)		−0.56	0.47			
(1′)		−0.52	0.40			
(1a)		−0.61	0.51		−0.41	0.50
Hildreth-Jarrett[h]	1920–1949					
Limited information (1)					−0.89	0.78
(2)					−0.76	0.75
Least squares (1)					−0.95	0.83
(2)					−0.76	0.75

[a] M. A. Girshick and Trygve Haavelmo, "Statistical analysis of the demand for food: examples of simultaneous estimation of structural equations," *Econometrica 15:* 79–110, April 1947.

Consumer elasticities calculated at the means of the period; farm price elasticity calculated at the means from a derived equation describing demand at the farm. The latter was obtained by substituting in the consumer demand equation prices received by farmers for retail prices of food utilizing for this purpose the relation between the two variables given by the equation describing demand by the commercial sector. The other values of elasticity relate to least squares estimates of the consumer demand equation: (1) and (1a) are linear in the observed variables; (2) and (2a) are linear logarithmic; (3) and (3a) are linear in first differences of logarithms. In the first member of each pair, food consumption per capita was used as the dependent variable; in the second member, the retail price of food was treated as dependent.

[b] Lois N. Shores, "A System of Structural Equations Explaining the Demand for Food in the United States," M.A. Thesis, University of Chicago, Ocotber 1946.

For the method of computing demand elasticity at the farm level, see footnote a.

[c] Marguerite C. Burk, "Changes in the demand for food from 1941 to 1950." *This Journal 33:* 281–298, August 1951.

Estimate (1a) is obtained from the equation treating price as dependent.

[d] Estimate (1) is given in Willard W. Cochrane, "An Analysis of Farm Price Behavior," Pennsylvania State College, School of Agriculture, Progress Report No. 50. May 1951.

Estimate (2) is derived in Willard W. Cochrane and Harlan C. Lampe, "The nature of the race between food supplies and demand in the United States," 1951–75. *This Journal 35:* 203–222, May 1953.

TABLE 1—(*continued*)

Commodity and study	Period	Retail level			Farm level	
		Price	Income		Price	Income
			Current	Lagged		
Meat:						
Fox[i]	1922–1941					
Least squares (1)		−0.64	0.56			
(1′)		−0.62	0.51			
(1a)		−0.67	0.58			
(1*a)		−0.93	0.80		−0.62	0.89
French[j]	1919–1941					
Limited information		−0.24	0.50			
Least squares (1)		−0.45	0.53			
(1a)		−0.71	0.58			
Shepherd[k]	1920–1941					
Least squares (1a)		−0.74	0.58			
Tintner[l]	1919–1941					
Reduced form		−0.79	0.56			
Weighted regression		−0.82	0.59			
Working[m]	1922–1941					
Diagonal regression (1)		−0.66	0.56			
(2)		−0.67	0.56			
Beef:						
Fox[n]	1922–1941					
Least squares (1′)		−0.79	0.73			
(1a)		−0.94	0.83			
(1*a)		−1.20	1.00		−0.84	1.07
Wahby[o]	1921–1941					
Reduced form		−0.77	0.65	−0.12		
Pork:						
Fox[p]	1922–1941					
Least squares (1′)		−0.81	0.72			
(1a)		−0.86	0.78			
(1*a)		−1.18	1.09		−0.65	1.06
Wahby[q]	1921–1941					
Reduced form		−0.91	0.77	0.29		
Eggs:						
Fox[r]	1922–1941					
Least squares (1*a)		−0.43	0.57		−0.34	0.49
Judge[s]	1921–1941					
Limited information		−0.58	0.44	0.29		
Reduced form		−0.29	0.35	0.30		
Least squares (1)		−0.53	0.31	0.22		
(2)		−0.56	0.41	0.27		

[e] James S. Duesenberry and Helen Kistin, "The Role of Demand in the Economic Structure," Chapter 12, pp. 451–482, in Wassily Leontief, *Studies in the Structure of the American Economy*. Oxford University Press, 1953.

[f] James Tobin, "A statistical demand function for food in the U. S. A." *J. Roy. Stat. Soc.* Series A *113:* 113–141, 1950.

Estimates (1) were obtained under the restriction that the sum of current and lagged income elasticities is 0.56. Estimates (2) were obtained without this restriction.

[g] Karl A. Fox, "Factors affecting farm income, farm prices, and food consumption." *Agric. Econ. Research 3:* 65–82, July 1951.

In (1) actual per-capita disposable income was used; in (1′) deflated per-capita disposable income. Equations are linear in first differences of logarithms of the observed variables.

[h] Clifford Hildreth and Frank Jarrett, "A Statistical Study of Livestock Production and Marketing," Cowles Commission Discussion Paper (Economics No. 2055 and Statistics No. 375), November 13, 1952.

Elasticities (1) calculated from equation linear in the variables at the means for the period; elasticities (2) are obtained from equations linear in the logarithms of the variables.

(Footnotes continued on p. 884)

Time-Series Complications. (a) Small samples. Consistency and efficiency are asymptotic properties that are not descriptive of the behavior of estimates in small or moderately small samples characteristic of studies employing time-series data. The possibility of substantial bias in moderately small samples for equations containing lagged dependent variables is suggested by a few studies that have been made.[8] (b) Autocorrelation. There is a strong presumption that errors and disturbances in economic variables are not serially independent. Least squares estimates of the coefficients of an equation containing a single dependent variable without lags remain unbiased if disturbances are autocorrelated but lose the property of minimum variance. The use of a first difference transformation has been suggested on heuristic grounds to improve efficiency.[9] Another procedure is to add an autoregressive equation for the disturbances and to estimate the coefficients of the two equations simultaneously. This procedure can be extended to multi-equation systems but will preclude the use of limited information maximum likelihood methods.[10] (c) Multicollinearity. The possibility that the variables in a given set may be constrained by another relation not specified by the model is recognized in the error model. It is doubtful, however, that methods based on intuitive considerations such as bunch map analysis are adequate to deal with the problem of the "unexpected relationship."

[8] T. C. Koopmans and Wm. C. Hood, *op. cit.*, p. 130.

[9] D. Cochrane and G. H. Orcutt, "Application of least squares regression to relationships containing autocorrelated error terms." *Jour. Amer. Stat. Assoc. 44:* 32-61, March, 1949.

[10] Lawrence R. Klein, *Econometrics,* Row, Peterson and Company, 1953.

(Continued from p. 883)

[i] See footnote g. Estimates (1*a) based on per-capita production; all other estimates utilize per-capita consumption. Estimates (1a) and (1*a) based on equation with price as dependent variable.

[j] Burton L. French, "The statistical determination of the demand for meat (Abstract)," *Econometrica 20:* 96, January 1952.

The consumption variable includes meat, poultry, and fish. The basic variables are apparently the same as those used by Tintner, footnote l.

[k] Geofffey Shepherd, "Changes in the Demand for Meat and Dairy Products in the United States Since 1910," Iowa State Agricultural Experiment Station, Research Bulletin 368, November 1949.

[l] Gerhard Tintner, "Static econometric models and their empirical verification, illustrated by a study of the American meat market," *Metroeconomica 2:* 172–181, December 1950.

The consumption variable includes meat, poultry, and fish.

[m] Elmer J. Working, "Studies in the Measurement of Demand with Special Reference to the Demand for Meat." Ph.D. Thesis, Harvard University, March 1952.

Of the many analyses given, the two selected are: (1) Analysis 4A which includes deflated price of meat, per-capita consumption, deflated per-capita disposable income and time; equations are linear in the logarithms of the observed variables; (2) Analysis 6 which includes the first three variables and is linear in the first differences of the logarithms of the observed variables.

[n] See footnotes g and i. Estimates (1*a) at the farm level refer to beef cattle.

[o] Omar Wahby, "Econometric Analysis of the demands for pork, beef, and poultry (Abstract)," *Econometrica, 20:* 97–98, January 1952.

[p] See footnotes g and i. Estimates (1*a) at the farm level refer to hogs, calendar year basis.

[q] See footnote o.

[r] See footnotes g and i.

[s] George G. Judge, "An Econometric Analysis of the Demand for Eggs," Ph.D. Thesis, Iowa State College, 1952. Additional variables were introduced in least squares analysis (2).

Discussion. It should be observed that there is no compulsion to base applied research in demand exclusively on one or another of the specialized models that have been described. It is ordinarily possible, and in a serious study would appear to be desirable, to experiment with several different formulations as well as with various versions of the same model. However, there are some general observations that can be made regarding the rival formulations, and these might lead one to experiment more extensively with the multi-equation shock model than with the other models.

(1) The error model in its single- or multi-equation form positing a complete explanation seems unrealistic when confronted with the admitted complexity of the behavior it is presumed to explain. The single-equation form of this model appears to be at variance with the usual mode of thinking about economic phenomena. Estimation procedures developed for use with this model are either of a make-shift character or are inefficient.

(2) The recursive shock model posits unilateral causal dependence for each equation in the system.[11] Basic to the model is a system of lags assumed to correspond precisely to the various stages by which a commodity moves from production to consumption. If these lags cannot be accurately represented, one must fall back to the notion of joint dependence.

(3) The argument for an uni-equational shock model is that for some commodities all but one of the dependent variables can be treated *approximately* as if they were predetermined or exogenous. The multi-equation form would appear to be thus generally *safer* since the likelihood of bias arising from such approximations is diminished.

Review of Studies

In Table 1 are shown estimates of demand elasticities for food and food products culled from various studies of the last decade. This compilation is intentionally incomplete: (a) estimates of income elasticity derived solely from budget data were omitted, (b) an estimate was not included unless an analogous estimate derived by another method was available, and (c) no effort was made to cover studies other than those dealing with interwar data in this country. The effect of these restrictions was to narrow considerably the range of commodities that could thus be reviewed. The measurements cited in Table 1 relate only to aggregate food and to certain food livestock products.

The limitations of this type of survey should be understood clearly. We are attempting to appraise the actual performance of alternative estimation procedures. There is undoubtedly a bias toward "acceptable"

[11] Herman Wold. *Demand Analysis*. Wiley, 1953, p. 14.

estimates in published or semipublished studies; the really unsuccessful computations seldom reach the final stage. There is an uncontrollable variation in the competence and skill with which a problem is formulated, the data compiled and processed, and the solution obtained. Even when alternative procedures are applied to identical data, there is always the possibility that different results will be obtained in other such comparisons. One should not expect clear-cut indications of the superiority of one or another method; the verdict, if one can be reached, is likely to be highly qualified and will need to be supported by other considerations.

Studies Employing the Error Model. There are on record only a few studies relying on the error model. Tintner[12] applied weighted regression methods to estimate the parameters of the aggregate demand function facing farmers and the aggregate supply curve for agricultural products in the United States using annual data (1920-1943). The demand equation is shown below together with its least squares analogue:

$$\text{Weighted regression: } x_3 = -0.097\, x_1 + 0.424\, x_2 + 0.313\, x_4 + v_1$$
$$\text{Least squares: } x_3 = -0.086\, x_1 + 0.407\, x_2 + 0.356\, x_4 + v_2$$

The observed variables are: x_1, prices received by farmers; x_2, national income; x_3, agricultural production; and x_4, time. In another study,[13] Tintner used the same methods to derive a demand and supply function for meat (1919-1941) at the retail level. The demand equation included per-capita consumption of meat, poultry, and fish, the retail price of this composite and per-capita disposable real income. Demand and income elasticities for meat derived from this equation are shown in Table 1, together with elasticity estimates also calculated by Tintner from the same data, using the reduced form method. The models used by Tintner are extremely simple, and it is not clear that the empirical results presented in these papers are intended as substantive contributions rather than as simplified illustrations of the arithmetical operations required in weighted regression fitting. Whichever may be the case, the estimates of demand parameters for meat obtained by Tintner do not appear to be out of line with the other estimates shown in Table 1.

E. J. Working also apparently adopted the error in variable approach in a painstakingly thorough unpublished study of consumer demand for meat.[14] Using annual data for the period 1922-1941 and carefully checked series of prices and consumption, he has estimated the coefficients of the

[12] Gerhard Tintner, "Multiple regression for systems of equation." *Econometrica 14:* 5-36, January, 1946.

[13] Gerhard Tintner, "Static econometric models and their empirical verification, illustrated by a study of the American meat market," *Metroeconomica 2:* 172-181, December, 1950.

[14] Elmer J. Working, "Studies in the Measurement of Demand with Special Reference to the Demand for Meat." Ph.D. Thesis, Harvard University, March, 1952.

demand equation linear in the logarithms of the observed variables (or in the first differences of logarithms) in some 22 different analyses. The general procedure employed is to obtain k estimates of each coefficient in an equation containing k variables by minimizing in the direction of each variable. Geometric means as well as the individual estimates for each coefficient are shown. This procedure is derived from some suggestions made by Frisch in an early study of the error model and can probably be characterized as a partial nongraphical bunch map analysis.[15]

It is difficult to choose rationally one or two equations as the best of the many presented in this study; the selections made for inclusion in Table 1 are almost arbitrary. Among some of the more interesting variants considered by Working are those in which he attempted to compare the "long-run" and "short-run" elasticities of demand for meat with respect to price and income, but the inferences made from them appear to be of questionable validity. The following equations[16] illustrate this approach:

$$(1)\ \log x_1 = -\ 1.051 \log x_2 - 1.295 \log x_3 + \text{other terms}$$
$$(2)\ \log x_4 = 1.118 \log x_5 + 0.548 \log x_6 + \text{other terms}$$

In these equations, x_1 is the retail price of meat; x_2, average meat consumption previous 5 years; x_3, percent given year consumption is of average of previous 5 years; x_4, consumption in given years; x_5, average of disposable income for previous 10 years; and x_6, percent given year's income is of average income for preceding 10 years. On the basis of equation (1) and similar evidence, Working argues that:

> "A smaller percentage change in price is associated with a one per cent change in the five-year average consumption than with the percentage which the given year is of that five-year average. Therefore we may presume that in the long-run the demand for meat is less inelastic than in the short run."[17]

Since $x_3 = 100\ x_4/x_2$ and $x_6 = 100\ x_7/x_5$ where x_7 is current year's income, equations (1) and (2) are equivalent to:

$$(1a)\ \log x_1 = 0.244 \log x_2 - 1.295 \log x_4 + \text{other terms}$$
$$(2a)\ \log x_4 = 0.570 \log x_5 + 0.548 \log x_7 + \text{other terms}$$

In equation (1a) the estimate of the parameter related to the "long-run" demand elasticity turns out to be positive. In equation (2a), the greater

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[15] R. Frisch. *Statistical Confluence Analysis by Means of Complete Regression Systems*. Publ. 5, Univ. Øk. Inst., Oslo, 1934.

[16] Equation (1) is taken from Analysis No. 7 and equation (2) from Analysis No. 13, E. J. Working, *op. cit.*

[17] E. J. Working. "Appraising the demand for American agricultural output during rearmament." *This Journal 34:* 206-224, May, 1952. The quoted statement is taken from p. 218.

effect on current price of past income than of current income, so striking in equation (2), is almost obliterated.

Studies Employing the Shock Model. There are probably not many more than a dozen econometric studies, altogether, based on the shock model; the number of such studies relating to demand for food is, therefore, quite small. Six studies providing limited information (or reduced form) estimates are cited in the basic table, two dealing with consumer demand for total food, one with demand at the farm level for total food livestock products, and the others with consumer demand for total meat, for beef, pork, and poultry, and for eggs. Time will not permit individual appraisal of these studies. Two general observations may be of interest:

(1) Limited information estimates of the coefficients of a given equation may be quite sensitive to addition or omission of explanatory variables in the remainder of the system. Two examples will be given. References to the studies cited are given in footnotes to Table 1.

(a) Below are shown two consumer demand equations for food linear in the observed variables (constant terms omitted) based on identical data. The first equation is part of a system containing five dependent and four explanatory variables; the second equation is part of a system which contains the same five dependent and four explanatory variables but includes, in addition to these, three other explanatory variables. Both equations are overidentified.

Girshick-

$$\text{Haavelmo: } y_1 = -0.246\ y_2 + 0.247\ y_3 + 0.051\ y_{3(t-1)} - 0.104\ t + u_1$$
$$\text{Shores: } y_1 = -0.356\ y_2 + 0.037\ y_3 + 0.469\ y_{3(t-1)} - 0.268\ t + u_2$$

The variables are: y_1, consumption of food; y_2, retail price of food; y_3, current income; $y_{3(t-1)}$, income lagged one year; and t, time. The striking difference between the two equations is the reversal of the importance of current and lagged income as a demand shifter. According to the second equation, the effect of last year's income is about 13 times as great as that of current income. It should be noted that this interesting result is obtained by *adding* explanatory variables.

(b) The second example is taken from a study by Judge of consumer demand for eggs. The system developed in this study consisted of 12 dependent and 10 explanatory variables, the demand equation contained four dependent and three explanatory variables and was thus overidentified. By omitting four explanatory variables, the demand equation could be made just identified. The two equations, linear in the logarithms of the observed variables, are given below (constant terms omitted):

$$\text{Overidentified: } y_1 = -0.582\, y_2 + 0.600\, y_3 - 0.487\, y_4 + 0.440\, z_1 + 0.289\, z_2 - 0.289\, z_3 + u_1$$
$$\text{Just identified: } y_1 = -0.292\, y_2 - 0.508\, y_3 + 0.226\, y_4 + 0.348\, z_1 + 0.305\, z_2 - 0.032\, z_3 + u_1'$$

In these equations y_1 is consumption of eggs; y_2, retail price of eggs; y_3, retail prices of meats; y_4, retail price of food other than eggs and meat; z_1, income; z_2, income lagged one year; and z_3 is time. The elasticity of demand for eggs is estimated by the first equation to be -0.6 and by the second -0.3; meat appears to be competitive in demand with eggs according to the first equation and complementary according to the second; this relationship is reversed for foods other than meat.

These examples are not reassuring. It is known that omission of explanatory variables not in the subsystem being estimated results in loss of efficiency, but some comfort is derived from the fact that the estimates remain consistent.[18] While the omission of four variables cannot be considered a trivial change in the system, still the effects seem rather substantial. There appears to be no definite explanation of the deleterious effects of addition of explanatory variables to other equations of the system.

(2) The second observation relates to a comparison of limited information estimates with least squares estimates computed from the same data. There is an unavoidable arbitrariness in such comparisons since the choice of the single dependent variable in least squares fitting is not unique. In Table 2, which provides the basic data for the comparison, the least squares coefficients have been obtained with quantity as the dependent variable, and the limited information estimates have been analogously expressed. In the majority of cases, the two types of estimates show good agreement, and this is true particularly of the food livestock products estimates (the first set of coefficients shown in Table 2 relates to an equation linear in the logarithms of variables, the second set to an equation linear in the observed variables). In all but the equations relating to meat, sufficient data are provided to permit the use of the conventional t-test of significance of least squares estimates. The following coefficients are not significant (at the 5-percent level): *food*—possibly lagged income, *food livestock products*—lagged consumption, *eggs*—prices of other commodities 1 and 2, *summer lemons*—time. It is perhaps suggestive that some of the large discrepancies occur with these "nonsignificant" coefficients. On the other hand, the "nonsignificant" coefficients of lagged income and lagged consumption are quite well approximated by least squares.

[18] H. Chernoff and H. Rubin, "Asymptotic properties of limited information estimates under generalized conditions." Chapter VII, pp. 200-212 in *Studies in Econometric Method*, Cowles Commission Monograph No. 14, Wiley, 1953.

Studies Based on the Single Equation Shock Model. Under this rubric, one would classify, with misgivings in many cases, the vast majority of empirical studies of demand and particularly the numerous analyses of factors affecting the price of this or that agricultural commodity. In the orthodox price analysis, the price of the commodity is ordinarily treated as the single dependent variable; the disturbance is implicitly assumed to be independent of all the explanatory variables which include quantity of the commodity, income, and possibly prices of other (related) products and time.

TABLE 2. COMPARISON OF LIMITED INFORMATION (L.I.) AND LEAST SQUARES (L.S.) ESTIMATES OF COEFFICIENTS OF DEMAND EQUATIONS COMPUTED FROM THE SAME DATA

Commodity	Method of estimation	Own price	Prices of other commodities		Income	Lagged income	Lagged consumption	Time
			1	2				
Food (a)	L.I.	−0.246			0.247	0.051		−0.104
	L.S.	−0.336			0.277	0.064		−0.234
Food livestock Products (h)	L.I.	−0.758	0.373		0.748		−0.031	
	L.S.	−0.765	0.378		0.753		−0.035	
	L.I.	−54.25	0.237		0.068		0.419	
	L.S.	−57.35	0.255		0.072		0.425	
Meat (j)	L.I.	− 0.428	−1.138	−0.938	0.169			−1.172
	L.S.	− 0.811	−1.137	−2.051	0.179			−0.778
Eggs (s)	L.I.	− 0.582	0.600	−0.487	0.440	0.289		−0.280
	L.S.	− 0.528	−0.001	0.168	0.308	0.223		−0.091
Summer lemons[a]	L.I.	− 0.188			0.0023			0.0080
	L.S.	− 0.216			0.0022			−0.0060

[a] Also includes index of summer temperatures for which the L.I. and L.S. estimates are 0.0049 and 0.0068 respectively. Taken from an unpublished study by G. M. Kuznets.

Note: Letters following commodity designation refer to footnotes in Table 1 giving specific reference to studies from which these estimates were taken.

The practitioners of the single-equation approach have not always been consistent or completely reasonable in their choice of the sole dependent variable. Karl Fox has ably defended the statistical validity of using price as the dependent variable in the measurement of demand for perishable or nearly perishable agricultural commodities largely on the grounds that (a) consumption is wholly or in large part predetermined and (b) consumer income can be treated as independent of the disturbance in demand equations for single commodities.[19] Concurrently, he has presented estimates of demand elasticities for such commodities, some of which are cited in Table 1, based on the use of per-capita consumption or per-capita production as the dependent variable. To obtain the estimates of elasticities of demand for food cited in the basic table, Cochrane first obtains the regression of food consumption on food price

[19] A detailed statement of this position is developed in: Karl A. Fox "*The Demand for Farm Products:* An Appraisal of the Applicability of Single Equation Methods in Statistical Demand Analyses for Agricultural Commodities." Ph.D. Thesis, University of California, 1952.

(or ratio of food price to nonfood price), income, and time. After adjusting consumption for variation in income and trend, he computes the regression of price (or price ratio) on adjusted consumption. To do otherwise, it is claimed, would be to violate economic convention since economists prefer to designate price on the vertical axis.[20]

Comments on two other studies listed in the basic table must be made. The first comment relates to the Duesenberry-Kistin study which provides the highest price elasticity for total food (−0.81) shown in our compilation. In this study, price elasticity is estimated basically from intercity variation in relative prices. The data employed for this purpose were taken from a variety of budget studies made in various localities over a span of some 25 years. Data wise, therefore, this study is not comparable with the other attempts to estimate demand parameters for food included in our survey.

The second comment refers to the first set of estimates of elasticities of demand cited in Table 1 culled from Tobin's study. As Stone pointed out in the discussion of Tobin's paper, these estimates are the offspring of an illegitimate union of conceptually different data. Under certain assumptions which Tobin developed, income elasticity estimated from budget data could be regarded as the sum of current and lagged income elasticities. Tobin's procedure was to estimate the parameters of the demand equation from time series under the constraint that the sum of current and lagged income elasticities equals the income elasticity estimates from budget data. The difficulty is that, in the cross-section sample, consumption was measured by expenditure on food and this includes total marketing costs, while in the time sample, consumption was measured by a price-weighted index of quantities of foodstuffs. The second set of estimates cited from Tobin was computed from time series data without such restriction on the parameters and is, therefore, more comparable conceptually to the other estimates computed from time series shown in Table 1.

Comparison of Estimates. We turn now to a general comparison of the estimates in the basic table. With respect to total food, if we omit the Shores' estimates, the first of Cochrane's,[21] the Duesenberry-Kistin figure, and the first of Tobin's, the remaining estimates exhibit little variation (demand elasticities: −0.25, −0.20, −0.29, −0.24, −0.28; income elasticities: 0.24, 0.24, 0.30, 0.27).[22] However, the Girshick-Haavelmo demand

[20] See footnote in Table 1 for publication reference.

[21] As pointed out by Working (see footnote 17 for reference) the first estimate of demand elasticity given by Cochrane is too high because adjusted consumption was not placed at the level of the mean of the period.

[22] With the exceptions already noted, the studies of demand for total food that are cited have used the BAE index of per-capita consumption of food as the measure

equation estimated by least squares with price as the dependent variable yields substantially higher estimates of demand elasticity (−0.53, −0.56, −0.61, respectively, for linear fitting, linear in logarithms, and linear in first differences of logarithms).

As we scan the remainder of the table, the only general conclusion that seems to emerge is that it appears to be possible to obtain "sensible" results with any formulation that has been employed. Group by group, there is closer agreement among estimates of income elasticity than estimates of demand elasticity, particularly if we omit Fox's estimates based on per-capita production. In some cases, differences in estimates can be attributed directly to differences in data. An example of this is the relatively high elasticities for food livestock products at the farm level obtained in the Hildreth-Jarrett study. In a few other cases the differences are apparently due to the methods employed. In general, however, the alternative estimates appear to be equally "acceptable." Since I have not been able to exhibit a study based explicitly on the recursive shock model, I cannot at this time endow this model with the power of producing acceptable estimates nor, to anticipate, with the power of producing unacceptable forecasts.

When we turn to a consideration of the predictive performance of the various models, the inability to obtain an appraisal of the alternative formulations in terms of the end results persists, but takes on a different complexion. In this case, alternative procedures tend to produce equally unsatisfactory estimates. It has not been possible to compute forecasts for each of the studies included in this review so that a general statement cannot be fully supported. The general tendency, however, is clear: analysis based on interwar data, whatever method was employed, by and large failed to account for the behavior of the dependent variables, at least in the immediate postwar years. Furthermore, as is apparent from Table 3, forecast errors tended to be consistently negative; prices and quantities were underestimated.

Promising Directions of Research

Various explanations have been offered to account for the failure of the demand equations estimated from interwar data to predict the behavior of the price and quantity variables in the postwar years. These explanations emphasize such factors as change in the distribution of real

of quantity. A question may be raised concerning the propriety of employing a price series which reflects variation in marketing costs with a quantity series that does not. In the discussion referred to previously, Stone cites a number of estimates of demand and income elasticity based on food expenditure deflated by the food component of the consumers' price index as the measure of quantity. Stone's estimates are consistently higher than those we have cited.

disposable income, lag in consumer adjustment to rapidly changing price and income situation, changes in eating habits, changes in the composition and distribution of the population, and so on. A good many of these factors are the kinds of variables that are tucked away in the ample *ceteris paribus* of the accepted theory of demand. To distinguish these from the purely economic variables with which demand theory deals explicitly, I shall refer to them broadly as social variables. Economic theory provides us with certain rather simple propositions regarding the kinds of economic variables that determine consumer purchases or consumption and the relations that obtain among these variables. These propositions are deduced with the help of a basic postulate specifying rational behavior and an equally basic condition regarding the fixity of

TABLE 3. PERCENTAGE FORECAST ERRORS[a]

	Food					Food livestock products			Meat	Eggs	
	Quantity		Price		Price	Price		Quantity	Price	Quantity	
	L.I.	L.S.	L.I.	L.S.	L.I.	L.S.	L.I.	L.S.	L.I.	L.I.	L.S.
	1		2		3	4		5	6	7	
1946	−8	<0.5	−2	<0.5	−17			−12	2	−17	−12
1947	3	−3	−10	−9	−21			−8	−26	−18	−18
1948	−0.5	−1	1	−6	−9			4	−27	−10	−20
1949	1	−1	2	−4	−6			4		−20	−19
1950					−4	−16	−16	<0.5		−16	−16

[a] Forecasted value minus observed value.
Notes: Cols. 1 and 2: Based on Girschick-Haavelmo demand equation (see footnote a, Table 1, for reference); revised series used in computing forecasts.
Col. 3: Based on computations by Burk (see footnote c, Table 1, for reference).
Col. 4: Taken from Hildreth-Jarrett study (see footnote h, Table 1, for reference).
Col. 5: Based on computations by Karl Fox (see footnote 19, for referenee).
Col. 6: Based on equation estimated by Shepherd (see footnote k, Table 1, for reference).
Col. 7: Based on computations by Judge (see ootnote s, Table 1, for reference).

the complex of social variables in the context of which economic behavior occurs. This theory has by and large provided the conceptual framework for empirical measurement of demand and it accounts in part, at any rate, for the extremely simplified models that are being used to estimate demand parameters. Economists have been greatly tempted to treat the social factors as fixed, in measurement as well as in theory.

There has been a growing recognition of the importance of determining the effects of changes in the social variables if demand parameters are to be properly measured. Time trends have long been used to take care of social variables that change slowly and smoothly over time. The use of lagged income and lagged quantity in demand equations explicitly recognizes factors that were assumed away in static theory. The fact that human behavior is not completely explainable is reflected in the disturbance which is attached to the demand equation. Are these adjustments sufficient? Can we be reasonably sure that the relations

among the economic variables which we are attempting to measure are unaffected by concomitant changes in the social variables? I think that the answer to this question is, probably, no, unless we restrict our analysis to a reasonably short period of time, certainly much shorter than that required for a time-series demand analysis. The really questionable premise underlying the empirical work we have reviewed is the assumption of a stable structure in a twenty-year period of rapid social change; this premise becomes more questionable as we consider in turn gross aggregates such as food, subaggregates such as livestock products, and finally individual commodities. Reanalysis of interwar and postwar data from a fresh point of view may yield some interesting results, but the possibilities of obtaining estimates of demand parameters which would be valid for current use appear to be quite limited.

One is confronted with a somewhat similar problem in estimating demand elasticity with respect to income from cross-section data. The expenditure of a family on food is conditioned not only by its income but also by a number of noneconomic variables which one cannot, in general, assume to be independently distributed of income. What the ordinary expenditure-income relation shows, then, is the combined effect of change in income and change in the complex of social variables.[23] Attempts to measure the purely economic relation by introducing such factors as size and composition of family seem pitifully inadequate. The ordinary budget study probably does not contain sufficient information to carry out some of the more important adjustments required to make the families in different income classes as Haavelmo puts it, more "homogeneous."

I think that it may be possible to measure the economic relation between expenditure and income which would be valid for the current configuration of the social variables from data provided by a well designed comprehensive budget study. But how are the price elasticities to be estimated? The interlocal price variation (which would have to be taken into account in deriving income elasticity) is not likely to be large enough to permit the determination of reliable estimates of response to different price levels. The possibility of obtaining such estimates experimentally has been suggested. In an interesting study, Godwin[24] used a 7 × 7 Latin square experimental design to measure purchase response to seven artificially established price levels for Florida oranges in seven retail outlets over seven weeks. This study presents estimates

[23] Trygve Haavelmo, "Family expenditures and the marginal propensity to consume." *Econometrica 15:* 335-341, October, 1947.

[24] Marshall R. Godwin, "Customer Response to Varying Prices for Florida Oranges." University of Florida, Agricultural Experiment Station Bulletin 508, December, 1952.

of elasticity of sales per sales opportunity (total sales of oranges divided by total number of customers) to price, computed apparently from a quadratic relating the two variables. It should be pointed out that such estimates refer to elasticities facing an individual retail outlet for a given product; they do not directly indicate the elasticity of consumer demand for that product. To obtain estimates of the latter, such a design would have to employ as units whole communities or, at least, broadly delineated shopping areas in which each of the retail outlets would have to be assigned the same level of price. An experimental design which would enable one to estimate cross-elasticities appears to be even more unmanageable.

Both price and income elasticities can be estimated from budget data if we extend the time dimension of the budget study. Data obtained from a national panel of consumers on purchases made and prices paid for the individual components of some fixed basket of food over a period of several years would provide us with unparalleled opportunities for measurement and testing of hypotheses in this area of economic behavior. Several experimental studies utilizing panel data for measurement of demand parameters are under way; and we shall soon have concrete, if tentative, evidence to discuss. At this time, analysis of purchases intertemporally and interlocally in static samples of consumers appears to offer a most promising approach to the measurement of consumer demand.

DISCUSSION

E. L. BAUM
The State College of Washington

The empirical economist has several methodological approaches available to him in the study of the measurement of consumer demand for food. Dr. Kuznets has chosen to ignore the evaluation of cross sectional studies of households in particular markets, demand-price reaction studies at the retail level, and the like. The emphasis of his paper was primarily concerned with a critical review of the alternative techniques employed in the statistical measurement of consumer demand for food and particular food commodities derived from time series data, national in scope. It appears that Dr. Kuznets chose a wise course of action in limiting the scope of his presentation. Perhaps an evaluation of the other techniques of demand measurement were ignored because many of these studies have proven to be inadequate for the purposes of ascertaining meaningful measurements of consumer demand for food, especially for predictive purposes.

It is of economic interest for policy makers of governmental bodies, marketing and production firms to know that the elasticity of demand for a particular food commodity and for a group of food commodities with respect to price or income is relatively low. This fact has been suspected by theoretical econo-

mists for over a century. However, it is important to have these postulates confirmed by statistical analysis. From a practical standpoint, it would be preferable to have a numerical estimate of the elasticity in question rather than talking about low or high elasticity, in general.

The problems associated with possible analytical errors in the least squares treatment of time series data, such as identification, possible effects of multicollinearity, interdependence of successive observations, etc., have led research workers to consider the demand function within the framework of a system of equations. These models are of both the static and the dynamic types. The system of equations is assumed to be linear. Further investigation is necessary to determine the relative correctness of the assumed linearity of the relationships. Some workers (Cowles Commission) assume that there are errors in the equations, but no errors in the variables. In many cases, it may be unrealistic to assume that the data are free from errors of observation. The static models are of some importance but are limited because of the dynamic factors which play such an important role in demand determination. The dynamic problem of social change which limits the temporal validity of static models might be approached on a basis similar to some of the older techniques of time series analysis; that is, conduct a series of successive estimates based on a fixed but short time period (if possible, much less duration than the full available data) and subsequently analyze the movement of the estimates of the parameters through time. Testing of results probably should rest as firmly on success in application as on purely statistical tests. The use of shorter time periods for data (e.g., monthly instead of annual) may increase the possibilities of accomplishing this, although certain statistical assumptions might be placed under greater pressure.

In a just identified system, the parameters are estimated by an adaptation of the least squares regression technique. What are estimated are not the parameters but certain functions of the structural parameters from which they themselves may be computed. This modification of the least squares method incorporates the interactions of the various relationships in the system under study.

Much credit should be extended to the workers using the Cowles Commission techniques especially in the development of dynamic demand models. Dr. Tintner prefers to use weighted regression rather than the Cowles Commission method. This technique permits the research worker to deal with errors of observations, based on the assumption of the existence of errors in the variables but not in the equations. This assumption may be questioned under many conditions. Professor Hurwicz has devised methods which deal with both types of errors, provided we have specific (exceptional) dynamic models. As yet, no methodology has been devised to handle both types of errors simultaneously in static systems.

A general objection often directed against statistical analysis of demand relations is the immeasurability of a number of economic phenomena the influence of "Psycho factors," or of expectations of the fluctuations of a price, or of consumption are in principle measurable. However, this does not mean that it is always easy to measure these influences. In practice they may sometimes be approximated by functions of lagged variables.

Dr. Kuznets made no comment on the use of annual data as against data for a shorter period. Perhaps the general problem of temporal aggregation may be just as serious as geographic and commodity aggregation. The tremendous

degree of aggregation found in all the examples cited by Kuznets may be an important reason explaining the similarity of results indicated for various models. More comprehensive (geographic and form) breakdowns of the structures might lead to highly significant differences. It is probable that the great amount of aggregation results in the unusual effects noted when the researcher alters the position and number of explanatory variables.

Perhaps if all econometric models were presented in greater detail, their utility may be increased. More thought and consideration ought to be given to the collection of more relevant data. The major problem is that of being sure of what is *relevant,* and that the relevant items are being measured.

The budget study approach appears as a very direct attack on the problem of the economic and psychological attitude of consumers on the demand for commodities in a complex aggregate. However, this technique by-passes the supply side of the matrix.

An important problem in most of the simple aggregative studies reviewed is the difficulty of accounting for changes in "Product" over the rather long time periods used. New techniques of processing and marketing make for a lack of homogeneity of product over time.

Dr. Kuznets has presented us with an excellent review of a large number of existing studies of the demand for food. He should be complimented for his scholarly contribution to our fund of knowledge.

FOREIGN AGRICULTURE TECHNICAL ASSISTANCE PROGRAMS

Chairman, T. R. Hedges, University of California

AN APPRAISAL OF FOREIGN AGRICULTURAL TECHNICAL ASSISTANCE PROGRAMS

MERVIN G. SMITH
Ohio State University

TO APPRAISE the position of agricultural technological development in the United States at the moment would be a very difficult job, and to appraise the foreign agricultural technical assistance (hereafter TA) in the world is even more difficult.

Descriptions are available for various TA projects, but appraisal is difficult because objectives and economic theories have not been fully developed in this broad area. Administrators of each agency and personnel working on each project are constantly trying to appraise their program, but there is need for overall appraisals. I have received such statements as this from personnel working in the field: "An evaluation of the entire program with a clear cut set of objectives that are understood by all should be the next step. This is essential to justify our U. S. taxpayer's money and also in fairness to the people in the recipient country who are, many times, expecting us to perform miracles."

A few attempts are being made to appraise programs as they are carried out. The evaluation of the Community Development program in India provided for by the Ford Foundation is an example. A two year study is getting underway at Chicago University on an evaluation of the projects in Latin America. This study which is being directed by Dr. T. W. Schultz is sponsored by the National Planning Association and financed by the Ford Foundation. These two evaluation projects should be valuable aids in planning future programs.

Our people have been confused greatly by each agency's attempt to appraise and disseminate information about its own program and ignoring the efforts of other agencies. We need to study all agencies together for better understanding and for getting better planning and coordination of the various programs.

History

There is no exact date when foreign TA was started. Exchange of information started with civilization. Missionaries, hundreds of years ago, are accredited with the first deliberate attempt at the exchange of "know-

how." For over 200 years, Americans have drawn on technical knowledge as well as capital from all parts of the world. Industry has been important in exchanging "know-how" along with its foreign investments. Philanthropic foundations have helped with improvements, especially in health and agriculture.

World-wide interest in TA has developed just in the last few years. A considerable effort was made in China by Rockefeller Foundation with the help of Cornell University starting in 1935, but it was interrupted by the war. The United States Government has carried on some work for about eleven years in Latin America and Liberia. This widening interest in TA is due mainly to increased communications, the great international tensions, large number of countries recently granted independence, and the attempt of the free world to do something to compete with communistic countries. Russia just has decided that she would contribute to TA in the United Nations and this means that it may be less effective in competing with communism.

It is doubtful whether this greatly increased enthusiasm for TA will last. Some of our people have expected changes too quickly. A few mistakes and unsatisfactory performances have led some people to condemn entire programs. The deliberations of Congress this year are indications of some of the doubts raised.

Programs and Number of Technicians

At least 5,000 to 6,000 technicians are working on foreign projects in the world. The United Nations agencies have about 1,200, United States Technical Cooperation Administration (Point 4) has about 1,500 and Mutual Security Administration (MSA) has about 1,000. We probably should combine MSA and Point 4 now because as of August 1, they were renamed and put in a new separate government agency called the Foreign Operations Administration (FOA). We have some 60,000 non-military United States Government workers abroad. We have between 15,000 and 20,000 missionaries of various categories.

Altogether, we have about 1,000 U. S. agricultural technicians working in foreign countries. I estimate a total of 1,500 to 2,000 agricultural technicians from all countries. As of April this spring, we had about 650 U. S. Agricultural Technicians in foreign work sponsored by United States Government and International Governmental Agencies. Of these, about 145 were with MSA, 371 were with Point 4, (285 were sponsored by USDA, while 86 were with Institute of Inter-American Affairs (IIAA) an arm of the Point 4 in Latin America), 51 were with United States Land Grant Agricultural Colleges (sponsored by Point 4) and 83 were with the Food and Agricultural Organization (FAO) of the United Nations.

Philanthropic and religious organizations are estimated to have about 200 agricultural technicians in foreign work. About 140 of these are agricultural missionaries. Besides these, some private businesses send American technicians to foreign countries.

A considerable number of other nations, especially Canada, Australia, New Zealand and European countries are sending technicians to foreign countries. About 238 agricultural technicians are working for the FAO besides those from U. S. Even some of the less economically developed countries of the world are exchanging a few technicians, qualified for special jobs, particularly under the Colombo Plan.

An increasing number of people from many countries are being brought to United States to study and observe. About 30,000 regular foreign students are in this country in colleges and a considerable percentage of these are in Agriculture. Of about 6,000 people brought here for short periods, about 3,630 were studying agriculture and cleared through the Foreign Agricultural Service of the United States Department of Agriculture. The U. S. State Department's International Information Administration is sponsoring about 8,000 exchanges, some of which are the regular students. Some voluntary groups are bringing about exchanges such as the International Farm Youth Exchange in which about 135 young men and women from U. S. are spending a few months this year in foreign countries and a similar number are coming to this country from other countries.

We have American technicians in nearly all the countries of the Near East, Far East, Africa, and Latin America. Our Point 4 and MSA, now called FOA, is operating in about 53 countries (35–Point 4 and 18–MSA) and possibly more by now. The FAO is operating in about 42 countries. Religious organizations have projects at least in 100 countries.

Expenditures for Foreign Technical Assistance

From one-third to one-half of the expenditures on most programs of TA are in agriculture, but it is common for 70 per cent and in some cases practically all of the expenditures to be for agriculture. Next largest expenditures are for health and education. Communications and industrial development follow these in importance.

It is difficult to total the money being spent on foreign TA. Most budgets are not broken down definitely as to the amount for technicians and the amount for materials or economic aid. The largest single amount is probably the U. S. Point 4 funds of $156.6 million in 1952-53. Even here there was an additional amount for material or economic aid. The United Nations Agencies have about $21 million in 1953 of which over $12 million comes from our Point 4. The Ford Foundation apparently is

supporting about $10 million of work per year. Indications are that the expenditures in 1953-54 will not differ much from these figures.

The Colombo plan has about $7.5 million per year for TA. It includes Australia, Canada, United Kingdom, New Zealand, India, Pakistan, Ceylon (as original members) and a few other Southeast Asia countries. It is a coordinated plan for the nations involved to work out their problems together. The total Colombo plan for six years originally called for about $5.2 billion, but this is mostly direct investment rather than TA. It is expected that the total expenditures will exceed the $5.2 billion considerably. The five- and six-year development plans set up by some of the countries fit in with the Colombo Plan.

Religious organizations of United States are spending a total of about $150 million per year for foreign missionary work of which not more than two or three million dollars are for Agricultural missionaries.

In all projects of TA where governments are involved, the recipient country contributes at least as much and usually three or four times as much as the country or foreign agency giving the assistance. Even with a few missionary projects, the recipient country has helped with land, buildings and school facilities. Governments have been stimulated by programs in recent years. This may be one of the most valuable parts to such programs, if they are not oversold on projects and get discouraged when improvements come slowly.

The expenditure for foreign TA programs seems to be high to some people, while others think it is low. In some cases it seems that a certain amount of money has been granted and then the administrators have searched for projects where they could spend the money in an allotted time. This is more the case with governmental agencies than with philanthropic or private agencies. The latter are more inclined to outline the projects and the financial needs and then seek the funds. This is one of the difficulties with most governmental financing. If allotted money is not spent, it usually is difficult to get additional funds when needed. This wastefull aspect of government may not be common from now on since many of the projects are already started and new ones will be attempted after the needs arise and some plans are made.

Those who think our United States total foreign TA expenditures are low, compare the expenditures with our total Foreign Aid program, including military and direct economic aid. It makes only between three and five per cent of this total. It costs us only ⅓ cent per person per day.

We might compare our agricultural TA expenditures, estimated at less than $100 million, as about the same as our Federal, State and Local Governments spend for Agricultural Extension Service in this country. Our Extension program is serving about 23 million farm people in this

country as well as some of the other people. The Foreign TA program is striving to start such service for at least 30 to 40 times that many people. Even with a contribution of three or four times as much from the recipient country, the expenditure per person in such countries is only five to ten per cent of that in this country.

It is much more important that our expenditures of funds be made in accordance with the capacity of the recipient countries to take it. Stanley Andrews, Administrator of the Technical Cooperation Administration (Point 4), has said that we tend to overstress things and money and understress time and people.[1]

It is not possible for a country to use millions of dollars and thousands of technicians in a short time. Small demonstrations have to be made first. It is necessary that the people grow into any program. There is a limit in the absorptive capacity of people and the time it takes for political and governmental personnel as well as the people to think through their problems and recognize the value of possible improvements within their country. Paul Huffman once said that "know-how" has to be imported; not exported. I believe we are beginning to learn these principles.

Value of Program

There are many ways to try to measure the value of Foreign TA programs. At least, they need to be considered from the standpoint of the effect politically (within our country and on International Relations), socially and economically. To express it in one term, the most descriptive might be the "well-being" of people. I think that the political effect of Point 4 in the short period since its announcement in 1949 has been striking. It has become better known by people over the world than almost any other non-military act of this country. It will likely be as famous as the Monroe Doctrine and Lincoln's Emancipation Proclamation. I think that historians will remember the period of the middle of the 20th century as the time when governments started to change their foreign policy to one of improving the welfare of people all over the world.

The direct economic effect of TA on the countries supplying it, such as U. S. has been very small so far, but the net economic effect is expected to be favorable in the long run. Although I cannot total the value of foreign TA work, even on the recipient country, I think it will pay out especially if we give it enough time. There is evidence that the application of technology in some areas of the United States has paid off at least 100-fold, when we consider the accumulative effect of it. Most

[1] Mr. Andrews has since become Director of the National Project on Agricultural Communications located at Michigan State College.

of the TA programs prior to 1940 were only in isolated spots in many countries of the world. Each one operated in a very small area without much coordination or attempt to cover a district, state or country. There are striking illustrations of local improvements in the well-being of people prior to 1940, mostly by agricultural missionaries. Many of these stories have been told.

The Rockefeller Foundation, the Institute of Inter-American Affairs and the Foreign Office of USDA have been carrying on expanded programs in some Latin American countries during most of the 1940's. Evidence shows that progress has been made. Production has been expanded. Health and sanitation have been improved. Foreign trade has increased at least four or five times in the last 10 years. But even with these improvements, some people are disappointed, especially when they compare these countries and their level of living with ours. In most cases, we have stepped up our production over the last ten or fifteen years faster than they have, and so the gap between our levels of living is still as wide as before. On the other hand, a number of people in these countries have changed their attitude from one of hopelessness to one of optimism. Even though the development so far may be small according to some measures that might be applied, there has been a basis established which will make it possible to generate an increasing rate of development. An indication of this is that the financing of the TA projects is being assumed more and more by these recipient countries.

The really large projects in TA have been started in the last three years. The Point 4, the United Nations TA and the Colombo Plan all started in 1950, but did not get well under way until 18 months ago. Considerable time has been spent in making surveys of needs and the setting up of projects. In some cases, the training of selected leaders has just started. What these people can do, in bringing about improvements, is still unknown. The stage is just being set for joint programs that would influence whole countries. These programs have been very successful in local spots, but the total effect on world food production in relation to population has been very small. Since World War II, population has increased faster than food production in the world.

Program Administration and Personnel

One of the chief criticisms I hear from personnel in foreign countries is the large number of agencies with separate administrative set-ups in a single country and the large percentage of the staff which are administrative. In some cases, there seems to be more administrative staff in our foreign delegations than technicians. This has been confusing to the recipient country. In some cases, the recipient country may be playing

one agency against the other. Some improvement in this situation may be taking place but much more needs to be done. Administrative work for more of the agencies should be handled by a common administration if at all possible at least within the recipient country. Some improvement has been made in Latin America by the establishment of "Servicios." It is an administrative body set up in the recipient country in which the programs are developed jointly by the recipient country and the representatives of the foreign agency. Even this may not be integrated enough as part of the recipient's government. Dr. Raymond Miller, Consultant for Point 4, says he would favor a change in the titles of the "Country Directors" of Point 4 and other agencies to "Chief Consultants."

Administrators of TA programs nearly all agree that one of their greatest problems is getting well qualified personnel to work on these programs. Apparently something more positive should be done by colleges and others to help prepare people for such work.

Another common criticism of the programs of the government which have been reported to me and according to my own experience is the short period which most technicians are assigned to a project or a country. There seem to have been too many experts sent to countries for short periods of a few weeks or months to make surveys and then prepare reports. These reports even may not get to the recipient country or may be delayed and do not become a part of the country's planning of their whole program. This has been in the preliminary part of the expansion of TA and from now on, more attention needs to be given to the carrying out of programs on a level with the people. Surveys of needs of the sort mentioned should be made only if they are wanted by the recipient countries for a particular use.

Missionary, philanthropic and business organizations have demonstrated that most successful personnel are those who are willing to make this their life work and are willing to live with the people where they demonstrate leadership. Such missionaries as Dr. I. W. Moomaw, Wilham Wiser, Sam Higganbottom and hundreds of others have shown this to us in the last 50 years. The Rockefeller Foundation has demonstrated this to some extent in Mexico where the U. S. technicians become a part of a Mexican Government Agency. The Mexicans feel that this is their program. The United States technicians stay more or less in the background and the Mexicans are given considerable responsibility for the program. Only limited success has been obtained in training Mexican leaders in the process of carrying out the work.

I agree with Karl Brandt, that there is a tendency for us to think that we have a monopoly on technicians and leaders in TA. A larger number of technicians and farmers with leadership ability may be available in some

European countries than in United States and they may be more willing to take a long time assignment or establish their permanent home in communities in the underdeveloped countries. However, many short term personnel have made important contributions to the programs so far. Many of them are conscientious and trying to do a good job, but many also have told me personally that they recognize the short assignments as definitely disadvantageous.

Many criticisms have come to me about the tendency for many of the technicians in government agencies to become closely attached to the foreign diplomatic corps and to circulate among the political and diplomatic groups rather than with their counterparts or with the people who are to be taught. This criticism of governmental agencies comes especially from private organizations and missionaries.

Missionaries and Other TA Programs

In most cases in the expansion of TA, we are not taking advantage of the experience of missionaries and private agencies in the countries. It is surprising how many projects are being carried out by religious agencies. For example, in one list of United States voluntary non-governmental agencies (mostly religious) in 1951, I counted 737 projects in India as follows: 28 in agriculture, 427 in education and 207 in health. In Mexico there were 83 such projects as follows: 6 in agriculture, 44 in education and 20 in health.

It is revolutionary to stimulate change and to bring about improvements in a country. People develop new wants and their religion may become inadequate to serve them in the new situation. If they are not taught good moral conduct, they may use violent means to try to satisfy the increased wants. Missionary work can be very helpful to other TA programs for the development of underdeveloped areas.

Reports have been made of some missionaries taking a very narrow view of other foreign TA programs. They fail to take advantage of help they might receive in their work by cooperating with the other programs. I have observed that rural ministers and priests in this country who are most successful participate with the people in all worthwhile technical and social programs. Missionaries and other agencies need to get together and improve their understanding and relationships.

Agricultural Extension Services

An important development in the last two or three years has been the increase in the number of countries which have established an Agricultural Extension Service. Many countries have had local agricultural agents, but most of them have performed regulatory and reporting serv-

ices rather than educational services. The people look to government as being regulatory, but they have not become familiar with it in an advisory or educational capacity. These recently established extension services hardly have operated long enough to prove themselves, but it is quite evident that different techniques, types of extension workers and organization are needed than in the U. S. extension service. Apparently success of extension services has been demonstrated in a few countries in Latin America. In most foreign countries, there has been little relationship between the agricultural education service and research. Often the research has not been the type to serve the farmer. The extension service operating in these foreign countries must include applied research or demonstration work. Some changes have taken place in the approach in foreign countries, but it will take years to perfect.

How much technical training a person needs to do extension work in these countries is a question. The programs have not proved yet in most countries how far farm leaders in the local area may be able to carry out the practical teaching, but the use of such leaders is being tried. More schools and technical teachers for farm leaders are needed. We have learned that the highly technically trained individual in many countries has difficulty in getting to the people.

Largest Programs Ever Attempted

The largest and probably the most dramatic program in foreign agricultural TA is the one which is getting underway in India and to some extent in Pakistan. A part of it is the large program to increase irrigation and improve health. The other important phase is the multi-purpose extension and demonstration type program with the village as the unit. Individuals, including missionaries such as Sam Higganbottom 25 years ago, and foreign governmental technicians, such as county agent Horace Holmes in the late '40's, demonstrated that great improvements could be made by working with the local village. Based upon this idea it is hoped that a program can be started in one-third of the 500,000 villages by 1956 and nearly all of them by 1960. Improvements are attempted in agriculture, health, education, and other areas. Training centers are being established where local leaders are given special training for about six months. Then these leaders are to go back where each one will live and work in about five villages. The program got under way in India less than a year ago, in October, 1952, and was started in Pakistan this summer. It is part of the country's five or six year program and the major part of the expense of it is carried by the recipient Government. It fits in with the Colombo plan. About 44 United States Agricultural technicians and a total of about 120 technicians under Point 4 were at work

on this project in India in April, 1953. The Ford Foundation is helping to support the training centers.

Much will be at stake in the progress made under this project. Already technicians there say that the program is moving much slower than anticipated. However they think there is a real chance that food production can be increased faster than population over the next few years. Problems mentioned by these people are: (1) Customs, religious beliefs and standards of living, (2) resistance to changes, (3) skepticism to white people, (4) understanding between high level officials and some officialism of officials, (5) line of authority to villager and to technician, (6) overestimation of United States methods and expectation of miracles, (7) poor avenue of information from research to farmer, (8) getting village programs to be planned and implemented by villagers rather than by officials.

Agriculture and Industry

There is argument at the moment whether agricultural or industrial developments should take place first. The agricultural emphasis is based on the urgency to produce enough food for the people. The industrial emphasis originates from the standpoint of finding use for the excess labor already on the land. The underemployment is so great that very little improvement for farmers can occur until some people can find jobs elsewhere. The problem is even more serious in India where unemployment also has increased greatly with the increase in population. If industrial development was enough to reduce the number of people on the land, the increased market demand would make it possible for the farmers to seek more efficient, as well as greater, production. Likewise, increased incomes will enable the farmers to purchase industrial products.

We have enough evidence that some improvements can be made in agriculture without industrial development. On the other hand, the improvement is limited sooner without industry. Attempts to develop industry in a wide area has not gotten under way and we are not sure of the methods by which it can be done. Probably both large and small industry can be developed in certain parts of some countries. However, in rural communities where the local organizations and associations are simple, it is believed necessary to develop simple and small industry that will fit in to the community without abruptly changing old habits, organizations and associations. In most cases, it means expanding or improving the efficiency of production and marketing in something that is already being done or for which there is already some demand either domestically or in foreign channels. The introduction of entirely new products or new

industries must be supplemental and necessarily gradual. Governmental leaders easily can get overly enthusiastic about bringing in large new industries. Unless they are well proven ahead of time, they usually require subsidy which becomes an added tax burden on the people. I believe there is great opportunity and need to develop the know-how in industrializing underdeveloped countries. We need applied research and demonstration in this area. Business development projects sponsored mainly by the International Basic Economy Corporation (Rockefeller financed) since 1947 in Venezuela and Brazil have been valuable. Some of these have been worthwhile to continue, while others have failed. There is evidence that if a demonstration proves an industry valuable, it will be expanded by the native people themselves.

Investment and Credit

TA projects are leading the way to increased investment and greater use of capital and credit. For large projects the United Nations Agency, the International Bank for Reconstruction and Development, plays an important part. The demands for funds from it have steadily increased. Outside investment is important, although the capacity of native people for supplying funds has not been determined. Recently a sizeable Government Bond issue in India was subscribed to very quickly. It is valuable for the people to get in the habit of saving and borrowing money on a businesslike basis. Much can be done to facilitate domestic investment through credit associations. The International Conference on Agricultural and Cooperative Credit in 1952 held at the University of California (financed by TCA, MSA and USDA) was valuable in stimulating attention to credit needs in underdeveloped countries and further study needs to be encouraged.

Land Reform, Tenure and TA

Many questions are raised concerning the relation of land reform and TA. Land reform is a phase of TA and long time development. Drastic land reform has not taken place as yet and it is not likely to be necessary or even wise before other technical improvements are made. Politically some division of large estates and some redistribution of land has been done and it may be necessary in order to satisfy the land hunger in a short period of time. The idea is too prevalent that the redistribution of land will make for greater total agricultural production and higher average individual incomes and will solve all problems. Production has been reduced in some cases where redistribution was done quickly and where holdings that were already small were reduced. It still leaves the same number of people on the land. The program followed in Japan

appears to have been very successful and is held as an example.

It may be more important that tenure practices are improved than that land be redistributed. The reduction of excessive rents and the wise use of credit and capital are likely to make for more efficient production and higher incomes. Larger and more efficient production may be possible if some farmers do not have to furnish the capital to buy the land. Progress has been made particularly in Formosa in improvement of tenure practices, but not much more than some proposals for a few changes have occurred in other countries. The governments need to attempt improvements in this area without bringing about open revolt. The inheritance systems and the system of social security or community and family interdependence followed in underdeveloped countries have been such as to resist greatly any changes. Many people believe that if improvments can be demonstrated on simple vital things at first, the attitude of people gradually will become one of accepting and desiring changes that can improve their well-being. Once this is started, they themselves will begin trying to improve many of their social customs and even such things as land ownership, tenure and inheritance.

Some emphasis has been given by TA agencies to land tenure problems. The Conference on World Land Tenure Problems in 1951 at the University of Wisconsin sponsored by MSA, TCA, and USDA was a valuable beginning in focusing attention to these problems.

Foreign Trade Policies and TA

Foreign trade policies can influence the success of TA programs. Some of the enthusiasm for TA is humanitarian or moral in character. With foreign trade policies and TA, our attention is focused on the changes in economic relationships involved. As commercial production is expanded, trade must increase. Since TA expands production, trade restrictions may limit the effectiveness of TA. If we influence foreign people to expand production of certain commodities we should agree at the same time to work toward freeing the trade of those commodities. Greater productivity often can be obtained most easily through the application of technology to those special products in which the country has the greatest comparative advantage and these are likely to be export commodities. At present, many of our people are tending to force us into more restrictive foreign trade policies and this will reduce the success of our foreign TA programs, especially in agriculture. Our Foreign trade policies and even our Domestic policies need to conform with our objectives in TA.

Conclusions

1. Even with the expanded TA Programs in recent years the foreign technicians are scattered very thin in the world. They are only

catalyzers and the real technological development will require a great effort on the part of the people within each country.

2. The expenditures for TA have increased greatly in the last three years, but it is small compared with the number of people for which it is spent.
3. The programs have had more political value than economic value so far. The length of time for changes to develop is so slow that dissatisfactions are likely to occur periodically and this will deter the programs. Very little direct economic effects on the highly developed countries have occurred as a result of the TA participation.
4. Administration of all the programs is still complicated and the availability of competent foreign personnel is seriously lacking.
5. Greater coordination of programs and cooperation of workers on different programs are needed.
6. Many new agricultural extension services are being organized but the methods, organization and leadership need to be developed which will succeed in underdeveloped countries.
7. The largest TA programs ever attempted are being started in India and Pakistan and even though progress may be slow, much will be learned in the next few years.
8. There is need to get started in small scale industrial development if agricultural improvement is to proceed very far and is to be permanent. Other factors such as education, health, and communications all are important.
9. Investment and credit developments have not proceeded fast enough to show more than some local improvements. Domestic sources of credit need attention and participation in organized activities should be further encouraged.
10. Land reform and tenure practices can be improved but should come with the development of attitudes of improvement or change and as technology develops.
11. Foreign trade policies and domestic policies need to conform with our objectives in TA. It is a serious question whether they may not hold back TA and in some cases counteract the favorable political effect of TA.
12. We have assumed too much that we already have the "know-how" to improve the well being of people in underdeveloped countries. It is still doubtful how much a country can be developed when it already has a dense population and a low level of living. About all we can say is that we have the scientific approach or a method for developing know-how in solving problems but we do not have

the know-how for answering specific problems in developing underdeveloped countries. We need to develop the scientific attitude in solving every small, immediate problem facing individuals.

13. The theories and principles back of TA may be sound, but the problems are great. Agricultural economists can help by making appraisals and developing objectives, theories, and methods in this area.

DISCUSSION

KENNETH H. PARSONS
University of Wisconsin

I shall attempt to comment on Professor Smith's excellent paper by developing a bit further two of three suggestions which he has made. In this, we shall address ourselves to some aspects of the question of how we, as agricultural economists, fit into the technical assistance function.

The general purpose or long-time intention of technical assistance programs is that a country or a cultural group shall be assisted in the adoption or development of ideas and practices to be put to work on their problems, which, it is hoped, will take root and grow there if they prove useful. This is essentially an educational process.

Our own country has benefited incalculably from such transplanting from the old world. What makes technical assistance an international problem now are two facts peculiar to our time: (1) the deep sense of urgency for meeting the problems of poverty and disorder—we need to find ways of speeding up and improving the flow of ideas; and (2) the shortage of dollars and other hard currencies which makes it impossible for individuals and even countries to freely import the technical assistance, ideas and practices which they need.

Many members of the craft of agricultural economists have been involved in this technical exchange, either as consultants in foreign countries, or as teachers or advisers to visitors here. Since this is an educational enterprise, it is through the teaching and training function that we are likely to make our greatest contribution. The ultimate procedural goal or ideal of technical assistance programs might well be the establishment of self-sustaining and self-generating educational systems in all parts of the world. The capstone in each country should be institutions of higher learning devoted both to fundamental learning and to public service. The overcoming of poverty, ignorance, disease and insecurity which are the ultimate objectives of technical assistance is the real job, for which our vast military efforts are now trying to buy time.

In this enterprise a group such as this would seem to have two very different functions: there is a great need to know, in vast areas of the world, just what the situation is—what is going on; these are questions of fact and our group as a whole has had a tremendous experience in making surveys, compiling statistics, collecting census data and so on. Although some European countries have good information about the rural economy and society, over the vast areas of the earth all too little is known to serve as anything like a solid foundation for programs and policies. Our methods in such matters are those suitable to a

literate society, with vast effective systems of communication, elegant machines for computation and analysis and relatively large funds. As many here can testify, if we are to be of assistance to students from countries without such facilities, we must adjust our thinking toward more elementary methods. But we are probably not so far away from the times when the pioneers in our craft were taking schedules by riding bicycles and buggies, that we can help bridge this gap.

The more difficult problem for us arises from the circumstance that what technical assistance demands from us is help toward development. This brings us back to considering what the classical economists called economic progress. Many here could no doubt give testimony to the stimulating effect which the current emphasis upon development is having upon our teaching and research programs. I shall not attempt any catalogue either of the new light in which old issues are seen nor the new issues that are arising—but we are clearly being pushed in the directions of the integration of the social sciences as well as toward the analysis of *processes* of economic growth—matters which have been largely excluded from the mechanical type of quantitative analysis to which most economists in America seem to have aspired in recent years.

I shall have time to comment on only one point—the issue of Marxism. If there can be said to be a prevailing economic doctrine or philosophy today, it is Marxism—taking the world as a whole. Furthermore, the doctrines derived from Marx are no longer appealing exclusively to the urban industrial proletariat. Communist-Marxism has now been extended, by Mao Tse-Tung and others, until it embraces a philosophy of peasant revolutions based initially upon land reform. It is an appalling fact, but nonetheless a fact, I believe, that the campaign of economic ideology among the intellectuals in most of the underdeveloped countries is being won by the Marxians. This is the challenge which our students who return to foreign countries, and we who go out, must meet.

The tragedy of the matter, from the viewpoint of those of us interested in democracy and genuine intellectual inquiry, is that it does not appear possible to work out a simple dogmatic theory of economic development which can compete in the short run in simplicity and appeal with the derivates of the Manifesto. This for the reason that no one can foresee in any fineness of detail the precise changes or adjustments that must or will take place in the processes of development in a society where there is extensive freedom. On the positive side two or three points are clear. In a time of great change and social fluidity, as now, power goes to the people with a program. If those who believe in the democratic way of life are to compete with Marxian dogma, they must have methods of filling in the vacuums being created by the great revolutions now going on. What remains to be tried under these circumstances, it seems to me, are the methods of investigations pointed to the critical issues of the time and place. If it is not possible to outline a program of development in detail, it still remains possible to put a group of trained investigators to work on the essential strategy for progress, whose tasks it would be to work out next steps.

I trust that the point of all this for the craft of agricultural economists is obvious. If there are investigators who can turn this trick they will be people trained in the political economy of agriculture—our colleagues in this and other countries or our students. The understanding of the problems of rural poverty and the requirements of rural development is our job. In country

after country the campaign is on to win the support of the peasants by promising needed reforms. The question before us is what we have to contribute to this enterprise. This is, as I see it, the deepest question and really the ultimate question for agricultural economists in the field of technical assistance.

DISCUSSION

HAROLD F. HOLLANDS
*Oregon State College**

This discussion largely supplements Dr. Smith's paper on a subject of such wide scope as to require more time for consideration than is available. Technical assistance is an important part of our domestic and foreign policies and probably will continue to be so; still, as Dr. Smith indicates, it has yet to be demonstrated that we have the know-how actually to improve the well-being of peoples in "underdeveloped" countries. Certainly there is no satisfactory method to appraise the work.

Because of my fear of Russia; because of the plight of the 65 per cent of the people on the earth who exist at levels only slightly above those of some of our own livestock; and because I think we must have good friends and allies, I believe that technical assistance is a God-given opportunity for us, the most privileged nation on earth, to work with others to help build a better world. But the task is important and difficult far beyond the conception of most Americans. Our intentions are generally good, but as a nation our thinking on affairs outside our boundaries is rudimentary. Some people are just beginning to realize that working successfully with strangers in their homelands is difficult; that significant and lasting changes in ways of living and working are likely to be slow in coming; that work must be started from the level on which the people live; that only rarely can or should things be done as we do them here at home; and that real accomplishments cannot be measured by the number of dollars spent or the speed with which they are expended.

"An Appraisal of Foreign Agricultural Technical Assistance Programs" is Dr. Smith's topic, based on accepted terminology, and illustrates one of our basic difficulties. The word "assistance" should not be used. Psychologically it is undesirable; actually it arouses resentment against us. Friends on the Continent have told me that too many Americans think the United States has all the technicians and know-how. Under these conditions use of the word "assistance" is indeed unfortunate. Nations are proud; they do not want charity. Most of them prefer to repay every dollar given them—if we would but permit it. They do not want to be "assisted" or "aided." Entirely new terminology, such as technical improvement or technological exchange programs, is an immediate requirement to help us here at home and our friends abroad realize our appropriate role in working to raise living levels.

Also we should recognize now that, with good cause, the United States is not liked abroad. We are respected for our wealth and power; we are feared. But our national lack of understanding, our egotism and arrogance, and our attitude of superiority do not help us make or keep friends. To be a good teacher, one must be a good learner, and certainly he does not regard his pupils

* Dr. Hollands worked three years on the food and agricultural program in Western Europe with ECA and MSA.

as being inferior. These technical assistance activities are essentially teaching programs.

If the importance of the general environment in which technical assistance should operate has been overly emphasized, it is because experience has convinced me that the finest technicians can be rendered quite impotent by national attitudes and by institutional and other handicaps put in their paths by well-meaning citizens, lawmakers and information agencies. After the expenditure of many billions of dollars it is beginning to be recognized that friends cannot be purchased and that working successfully with friendly nations requires a combination of sincerity, understanding and humility which has not been sufficiently evident in our relations with other countries.

Appraisal of technical assistance work indicates that the number of exclusively American government and private organizations is too large for most efficiently utilizing our available resources and personnel. Here at the top is need for much greater cooperation among agencies carrying on technical assistance programs; and these include governmental and non-governmental agencies, in so far as possible. What work and where it should be done, the time schedule to be followed, the best methods and most qualified agencies to be employed—these and many other vitally important decisions need be made by highly qualified men here and abroad well before a program is undertaken in order to reduce chances of failure to a minimum. Programs in which we participate should improve the well-being of peoples. Certainly they must not worsen existing problems, such as surpluses in population and agricultural products. Failures here at home we can accept and find someone on whom to place the blame, but our failures abroad are sure to cause very serious consequences and might well give more strength to communism than if we had no program at all. We must never think, or permit anyone else to think, that we have all the answers for improving well-being on the earth.

In many areas industrialization is essential and this means making very difficult decisions and possibly arousing open opposition. Friends of American agriculture and workers for higher living levels everywhere probably should now be concerned about the relatively few technical assistance projects in non-agricultural industries, some of which see no advantage to increased industrialization abroad.

Closely associated with needed coordination of agencies engaged in technical improvement programs is the problem of personnel briefly mentioned by Dr. Smith. In areas like Northern Europe some technical improvement can be accomplished quickly and effectively, but in the truly "underdeveloped" countries most technical assistance is a long-time program into which properly qualified Americans will fit satisfactorily only after some months or years of foreign service experience. Trained men and women who plan to spend their lives abroad in their chosen fields are essential for a strong United States technical assistance program. This requires a national awakening to our responsibilities and opportunities so that such people may be promptly and adequately trained. Technicians so qualified will build more good will and understanding for the United States than millions of words broadcast or printed for that purpose.

One method for appraising technical assistance is to permit foreign participants in such programs to make the appraisal. Because they hesitate to hurt our feelings, it is difficult to obtain unfavorable comments, however, I have heard the following: American technicians train too few foreign teachers qualified

to train more teachers; some American technicians do not understand local conditions, do not remain long enough to understand them, and recommend and try to follow practices which are not adapted to conditions; and personal displeasure is evidenced very strongly by some Americans because of the delay and slowness with which their suggestions and programs are accepted and put into action. Criticisms of those who have visited the United States on technical assistance projects are generally favorable, but some participants believe they did not see as many places or people as they should have seen; they did not have time to observe all they wished to see; or they did not feel welcome to some industry groups. Several have told me that Americans should not attempt to build another United States of America in other countries.

Nearly every participant with whom I have talked mentioned our kindness, hospitality and willingness to answer questions and to show him what he wanted to see. These men were especially impressed by the sense of freedom—freedom to go where they pleased without police permits and to see what they wished to see; freedom to make statements and to ask questions; freedom to give and to receive answers. All this is indeed complimentary in today's world. It is my conviction that a strong, national technical improvement program could help us keep these freedoms, and also could help other less fortunate men and women enjoy more freedom and much higher living levels than they have today. United States "technical assistance" is now on trial over the earth.

STUDIES IN MARKETING EFFICIENCY

Chairman: Barnard Joy, Agricultural Research Administrator

CONTROLLED EXPERIMENTS IN RETAIL MERCHANDISING

MAX E. BRUNK
Cornell University

IN RECENT years marketing researchers have displayed an increasing interest in retailing problems. Gradually we are recognizing that many manipulative factors, other than price, play an important role in determining the volume of given goods sold in the retail market place. In the past we have emphasized the importance of price almost to the exclusion of everything else but more recent research reveals other retail merchandising practices which exert a tremendous influence on consumption patterns. Thus, a largely unexplored and fertile area of marketing has evolved calling for the development of research methods adequately designed to attack new problems.

It is significant to note that the sudden rash of merchandising studies the past few years has dealt with individual products rather than with groups of commodities or with food as a whole. Although practical merchandising problems exist at all levels, those appearing most vulnerable to attack are on the individual commodity level. At this level we are concerned with the competitive advantage of individual products in the market place as well as with increasing the efficiency of food marketing in general. I am not too concerned about those skeptics among us who argue against the commodity approach on the basis that finding more attractive ways of satisfying consumer demand for one product merely accomplishes a shift in demand from other products. While admittedly this occurs to a very great extent (if we are successful!), our skeptics must concede that in the process the consumer has been better satisfied else it is likely that no shift in the consumption pattern would occur. One does not have to claim gains in competition with non-foods, although such gains may on rare occasion occur, in order to justify the expenditure of public research funds to better even the short-run competitive position of some disadvantaged product. Accomplishing the latter alone is a worthy objective and of benefit to a more stable agriculture.

It is beyond the scope of this paper to explore the effects of the growth of supermarkets and "one-stop" shopping centers on consumption patterns other than to emphasize the role they have played in increasing competition between different products within given outlets at the expense of decreasing the competition of given products between outlets. The

resulting increasing degree of imperfect competition for given products between outlets places an even greater commodity-approach challenge before the researcher.

General Approaches

Several different basic approaches might be used in determining the effects of retail merchandising practices on sales: (1) The problem may be studied by using historical data correlating certain changes in given merchandising practices over time with trends in sales. (2) The problem may be studied at any given point of time using sample surveys of actual merchandising practices and relating them to sales. (3) The problem may be studied under controlled or laboratory conditions using experimental designs. Under certain circumstances various combinations of these approaches may be desirable.

Marketing researchers have long applied the first two approaches so that the techniques involved are familar. The experimental approach in marketing is relatively new and the techniques are currently in a highly developmental stage. Controlled experimentation should be particularly intriguing to the researcher because of the frustrations he has experienced with other approaches in isolating the specific effects of given variables. The multitude of merchandising practices which are normally blended in the market place make it virtually impossible statistically to eliminate confounding effects. But assuming that the effects of non-test variables sometimes can be satisfactorily eliminated by our known methods of sample stratification or statistical analysis, it must be recognized that the historical and survey approaches are limited to measuring the effects of only those merchandising practices in common use.

In evaluating the usefulness of controlled experimentation it is important to recognize that the historical or survey approaches offer no solution to the really live questions in marketing which deal with measuring the effects of either unusual practices or innovations. This is a serious restriction indeed for much of marketing research is or should be concerned with the development of improved (new) marketing practices.

All too often, economists are inclined to accept an increasing trend in the application of certain practices as evidence of desirability and thus ignore the fact that many such practices are institutionally born and forced on the consuming public without justification in costs, sales response, or consumer preference. Our system is not so perfect that all things done in marketing arise from either actual or anticipated economic forces.

Certainly the researcher must keep in mind that solutions are nothing more than a stage in development. In this sense solutions to marketing

problems are sought only in terms of improvement over existing practices. The theoretical potential of market development is always beyond grasp with the area between present practice and theoretical perfection always offering a fertile field for research.

Development of Controlled Experimentation

Because most studies of merchandising practices have been concerned with measuring the effects of alternative practices on volume of sales, this paper is directed at the development of experimental designs for this one specific purpose. This does not deny the importance or need of designs for other worthy objectives such as the measurement of consumer preferences but it serves merely to limit the scope of this discussion. Marketing researchers apparently find it difficult to confine their studies to single and precise objectives, but they must come to this end if they are to successfully employ controlled experimentation.

One of the first controlled experimental designs to develop in marketing consisted simply of matched lots.[1] By this technique two or more lots of the product under study are placed on sale side by side in x number stores. The matched lots vary only in the characteristic being studied. The technique is in very common use today. It offers the most satisfactory and complete means of eliminating the effects of non-test variables. It provides perhaps the most effective tool for measuring *shopper* preference. Unfortunately it is not suited for measuring the effects of merchandising practices on sales although a review of the literature will reveal that the technique was developed and is today still widely used for that purpose. In this respect the matched-lot controlled experiment has provided a large number of false inferences regarding the effect of certain merchandising practices on volume of sales. The only valid inferences which can be drawn from matched-lot experiments are restricted *entirely* to shopper preference. The fact that shoppers purchase two, three, or ten times as much from one lot than another cannot be translated into what effect either lot offered alone would have on sales. It is entirely conceivable that the same shoppers purchasing three times as much from lot A as from lot B will actually purchase *less* in the market place when only lot A is offered compared with when only lot B is is offered because the preference *intensity* of those shoppers selecting B may be much stronger than of those selecting A.[2] We will not be able

[1] Donald A. Van Waes, "Evaluation of Research Techniques Used for Measuring the Influences of Factors Believed to be Associated with Volume of Consumer Purchases in Retail Stores" *Methods of Research in Marketing*—Paper 1, Cornell University, July 1951.

[2] A hypothetical case will illustrate the point. Assume lot A (above) is milk in cardboard cartons and lot B is milk in glass bottles. Offered side by side at the same price,

to predict actual performance from preference information until we know far more about the components of preference and develop means of measuring the intensity of those components.

It is indeed regretful that so many researchers reporting findings from matched-lot tests initially recognize and state that they have measured only preference and yet proceed to draw expressed or implied inferences in regard to sales. Apparently these individuals cannot resist the temptation to thus magnify and distort the significance of their findings which otherwise would have little applied meaning.

However, early matched-lot experiments served to stimulate thought devoted to the development of designs suitable for measuring the effect of merchandising practices on sales. It emphasized that such a design should permit the measurement of test variables under conditions essentially the same as those found in the situation in which the results are to be applied. Holding to this criteria, only one merchandising practice (treatment) can be tested in any given store at any given time. Therefore, the effects of different merchandising practices must be tested either in different stores at the same time[3] or at different times in the same store. But under either of these circumstances store differences or time differences are sure to produce effects confounded with treatment (merchandising practice) effects. Since time and store differences represent two major sources of variation, an experimental design permitting two-way elimination is desirable. Such a design was developed and used at Cornell University in 1948 for the purpose of determining the effects of bruising on the retail sale of apples. In this experiment, four lots of apples varying only as to bruising were sold through sets of four stores over a four-month period. Only one lot of apples was offered in any one store at any one time. The lots were rotated monthly so that all four lots were tested in every store as well as in every time period. Sometime later, it was discovered that this was nothing more than a simple latin-square design. Since that time, we have conducted some 34 latin-square experiments in studying apple sales and have continually sought improvements in the design.

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relative sales reveal a decided preference for cardboard. Consequently, the merchant switches entirely to cardboard and sales decline. He then changes to glass and sales increase. In this case, some shoppers may have suspected that the wax on the cardboard contained a pork product so objectionable to their religion as to create for them a strong preference for glass. On the other hand, those who preferred milk in cardboard did so only because of a slight convenience which they were willing to forego when only bottles were available.

[3] This is essentially the same as the matched-store approach described by Applebaum and Spears in "Controlled Experimentation in Marketing Research" *Journal of Marketing*, Vol. 14, pp. 505-517, January 1950. It is interesting to note that Applebaum and Spears were developing this technique independently and simultaneously with the development of the use of the latin-square design at Cornell University in 1948.

Application of the Latin-Square Design

The successful use of the latin-square design requires a minimization of time and store differences and a maximization of treatment differences. This immediately raises two questions. How frequent should the treatments be rotated in the stores? What range of store conditions can be safely covered within the limits of obtaining significant results? Only experience can answer these questions.

In our 34 experiments we have searched for the optimum rotation period by rotating treatments twice daily, daily, weekly, bimonthly, and monthly. We have found no great difference. In 1950, we rotated a large number of treatments twice daily and daily.[4] In 1951, we rotated the same treatments weekly and bimonthly. The effects produced by the treatments in the two years were almost identical. However, it was observed that the coefficients of variation were greater for the twice daily and daily rotations. Reasonable rotation periods will logically vary with different products depending on the frequency of consumer purchases. Additional experience now being gained from a fairly wide spread use of the latin-square design should supply within several years a far more adequate answer to this question.

Perhaps of more serious concern is the fact that the rotation of treatments within given stores creates, over time, an abnormal store condition. Preceding treatments in a store may bear some influence on subsequent treatments. Because the rotation of treatments is necessary for the elimination of store and time effects, the only recourse rests in the statistical measurement of the carryover effects. This was accomplished essentially by "tying" two latin squares together with the rotation of treatments in one being the reverse of the rotation in the other.[5] This double change-over design was adapted from a technique used in a dairy cattle feeding experiment.[6] The double change-over design retains the advantages of the latin square in eliminating store and time effects and at the same time permits the measurement of carry-over effects. If carry-over effects are not present, the individual latin squares may be considered essentially as replications.

The latin-square design is well suited to determining those merchandising practices which stimulate sales in the short run. By no means does

[4] Bennett A. Dominick, Jr. "An Illustration of the Latin Square in Measuring the Effectiveness of Retail Merchandising Practices" *Methods of Research in Marketing*—Paper 2, Cornell University, June 1952.

[5] Peter L. Henderson, "Application of the Double Change-over Design to Measure Carry-over Effects of Treatments on Controlled Experiments" *Methods of Research in Marketing*—Paper 3, Cornell University, July 1952.

[6] W. G. Cochran, K. M. Autrey, and C. Y. Cannon. "A Double Change-over Design for Dairy Cattle Feeding Experiments," *Journal of Dairy Science*, Vol. 24, pp. 937-951, 1941.

the design serve to measure long run effects. Other and less perfected techniques are required for this purpose. Nevertheless practices which prove effective in the short run can be identified through latin-square tests and these practices in turn can be subjected to matched-store tests for long run effects.

Unfortunately experience with varying store conditions has not been as great as with time differences. In our series of experiments, we made efforts to select stores as similar as possible in every respect. Even so, we found the variance in our experiments due to store differences slightly greater than that due to time differences. This proved true for all five years during which the experiments were conducted in the stores of several chain organizations. The stores included in any one design were always of the same chain organization because centralized management served to minimize store differences. The period of time in these tests covered three or four months in each year. This experience suggests that comparing treatments over time in a given store would yield more reliable results than comparing treatments between stores at any given time. This observation, of course, is based on experience with fresh apples and may not hold true for more seasonable goods.

But the chief concern of researchers deals with how far generalizations can be made from experiments conducted in highly selected stores. The same question, of course, applies to all types of incomplete enumerations whether they be based on surveys or experiments. Because of incomplete information on variability and size of the population, the general advice of the statistician in either case crudely appears to be: "Get all the observations you can within the limitations of your time and money and hope in the end that you have enough." Because extent of coverage is based largely on resources and because experiments are more expensive to conduct per unit of coverage than surveys, researchers are often inclined to discard the experimental approach. Many of our concepts concerning adequate sampling are based on experience with surveys in attempting to measure the effects of certain variables in an atmosphere where they are confounded to a very high degree with other variables. It is difficult to adjust these concepts to the conditions of a controlled experiment under which the disturbing effects of a very large number of non-test variables are eliminated. About all we can be certain of is that fewer observations are needed as disturbing effects are removed. Only experience can reveal the degree of difference.

Although our series of apple experiments was conducted in only 20 retail stores of a highly selected type located in but 12 towns and cities of western New York, the results have been generally and successfully applied throughout all parts of the country. Statistical records of experience are available in many instances, and these verify the experimental

findings. These results may have been obtained because merchandising practices applied to apples as well as competing products were fairly uniform throughout the country and the sales response to the improved practice on apples was very large in the experimental tests. As a result, changes to the improved practice brought about favorable response over a wide area in spite of the fact that other practices, not responding so well in the New York tests, might have yielded still greater results in these other areas.

In conducting controlled experiments, additional information is usually available at little or no cost which might be valuable in refining analysis. However, in the Cornell tests the analysis of covariance of apple sales and total number of customers, total grocery sales or total produce sales was of limited usefulness. The removal of store and time interval differences in the latin square accounted for most of the relationship between the covariate and volume of apple sales. The residual variations were not related to any extent. If the variation due to store and time intervals were not removed then covariance analysis may be expected to decrease the error variance considerably, but not to the extent accomplished by the latin square. In other studies, the use of covariance analysis may prove quite beneficial. It is simple to conduct and serves well as a precautionary factor.

Perhaps the greatest contribution of controlled experimentation to marketing research is that it permits measurement of the effects of innovated practices. It also lends itself admirably to the development of innovations. This latter point is not generally recognized. For example, the merchandising practices (treatments) used in the apple experiments were not at all identified and selected at the outset. At first, a series of tests was conducted to determine the effect of size of pricing unit on sales of bulk apples. This revealed that commonly used pricing units were too small. Another series of tests revealed an advantage to prepackaging over bulk displays which apparently stemmed from shopper convenience. However, it was obvious that as the size of package unit increased above a certain determined point that inconvenience on the part of certain shoppers would set in if bulk apples were not available. Then because prepackaging proved desirable, a series of tests was made to determine the most acceptable type of packaging material. Combining experiences from these tests led to a new series of treatments consisting of displays of a combination of bulk and prepackaged apples, the latter being put up in the most acceptable type of packaging material. The final series of tests served to determine the optimum size of pricing unit and package for such combination displays. The result proved to be the most effective merchandising practice among some 20 different ones tried. This sequen-

tial selection of treatments permitted innovation by systemically allowing the shoppers through their preferences to guide the building up of the end product.

Combining Surveys and Controlled Experiments

There are numerous instances in marketing research where surveys and controlled experiments can be combined to advantage.[7] Because controlled experimentation lends itself to studying the effects of variables not commonly found in the market place, it is sometimes desirable to conduct companion surveys in order to interpret the significance of the results of controlled studies in terms of actual market conditions. Such a tie-in of the two techniques was made in connection with our investigations on the effect of bruising on the sale of apples mentioned earlier in this paper. In this case, the companion studies furnished two important items of information: (1) The extent of bruising necessary to reduce the volume of apple sales was precisely determined by controlled experimentation in 12 stores in 12 cities. (2) The extent of bruising on apples normally found in the market place was determined by a simultaneous sampling of 504 other stores in the same 12 cities. With this combined information, growers and merchants were informed that present methods of handling apples were not causing sufficient bruising to materially reduce sales. Only two per cent of the apples found in the sample survey were as badly damaged as the experimental treatment which had the most bruising and this treatment was the only one to which buyers responded through decreased purchases. Measuring the effect on sales of this two per cent would have been practically impossible if only the survey data had been available. This illustrates one of the differences between controlled experimentation and sample surveys and how the two can be combined to advantage.

In marketing research we have identified many of the influences causing those variations among retail stores which give us great difficulty in sampling. Such identification has been important but is of limited use in sampling because we have not been able to measure such variations quantitatively. There is good reason to believe that in the future experimental designs will aid tremendously in such measurement and thereby enable us to do a far better job with probability sampling.

By no means is controlled experimentation a panacea for marketing research. After it passes through the fad stage, it will probably emerge in proper perspective as one more valuable tool in the work kit of marketing researchers.

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[7] Max E. Brunk and Walter T. Federer. "Combining Probability Sampling and Experimental Designs in Marketing Research" *Journal of American Statistical Association*, Vol. 48, No. 263, pp. 440, September, 1953.

ECONOMIC-ENGINEERING METHODS IN MARKETING RESEARCH*

L. L. SAMMET AND B. C. FRENCH**

THE broad classifications of marketing include the assembling of farm products; their processing, packing, and transportation; terminal market operations; and wholesale and retail distribution. Each phase is a process containing many operational components or "stages." Experience indicates that similar types of jobs are performed in all phases of marketing. Therefore, if marketing research is analytical, the methods of study—and frequently the results—in one phase may be applicable in other phases. This interchange of methods and results can apply also to different commodities.

The most appealing aspect of marketing efficiency studies is the possibility of developing sweeping innovations that result in major cost reduction. Changes of this sort, however, are rare. More commonly, long-run improvements result from numerous small improvements in the individual stages of different marketing phases. Whether the outlook is for an unspectacular accumulation of small improvements in various stages or a major innovation, research methods and the presentation of results should be designed to show how costs and output in individual stages are affected by changes in method. This procedure should also be extended to show the impact of changes in technique in any stage on total costs in a given process, on costs in a production area, or in an entire industry.

Relationships of this sort do not stand out from masses of data but are developed with the aid of carefully formed theories and hypotheses. It is important that formulation of the theoretical framework precede any research, for the theoretical concept will affect the types of data collected, the conclusions drawn, and, in general, the design of the experiment. While it is not possible to present a theory for marketing efficiency research in this paper, several theoretical concepts may be noted.

Theoretical Concepts

A theoretical frameork for studies of efficiency in the production of marketing services can be developed by elaboration of the conventional

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** Both authors are Cooperative Agents, California Agricultural Experiment Station, and the Bureau of Agricultural Economics, U. S. Department of Agriculture.

theory of the firm. This involves introduction of the following ideas: (1) production processes actually involve many separate operations, or "stages," in contrast with the single stage processes usually assumed; (2) rate of output may be varied by multiplying the number of identical production units employed; and (3) because rates of production do not always correspond directly to rates of consumption, or sale, total output for any period commonly is varied by changing hours of operation per time period.

These circumstances lead to several departures from conventional theory. For example, expansion of output through time—with constant rates of input for each factor of production—results in linear input-output relationships. This is in contrast with the curvilinear functions that reflect the diminishing returns resulting from intensification on fixed factors of production. Similarly, linear functions will be found where output is expanded by varying the number of identical factors used in performing a particular operation without intensifying on the use of any of these individual units.

In contrast with the continuous functions of conventional theory, cost functions developed within the above framework will be continuous in the time dimensions but discontinuous as rates of output vary.

When production processes are visualized as consisting of numerous separate stages, the development of a long-run cost, or "planning function"—commonly described as an "economies of scale curve"—becomes a problem of integrating the alternative methods of operation available at each stage so as to obtain minimum production costs at any rate of output. Each point on the long-run cost curve defines a plant representing a specified set of equipment units, buildings, and organization.

Another pertinent aspect of production theory is that in the long run all factors are variable. This is not true for the short run because every process involves durable goods that are fully consumed only through use in several different production periods. Once durable factors are purchased, these elements become fixed. In fact, we have a "plant" as soon as one or more factors in a production process are fixed. Thus defined, a "plant" may be a canning or packing plant, a terminal market, an auction, retail milk delivery equipment, or harvesting and assembly equipment.

What Kind of Study is Required?

From a recognition of the stage organization of production processes, it follows that aggregate cost studies may reveal little with regard to the effect on costs and efficiency of variations in individual stage techniques. This puts an especial burden on accounting cost studies because account-

ing records alone often are not detailed enough to permit cost allocations to particular plant stages. Other difficulties include the establishment of meaningful relationships between allocated costs for particular stages and rates of output and the existence of significant variations between prices paid in different plants for variable factors purchased in a given period and in prices paid for durables purchased in different periods.

Some of the difficulties in purely accounting studies can be overcome, at least in part, by direct observation and measurement of particular plant operations and by the use of physical reference data from engineering. Depending on the nature of the problem, the types of data available, and the objectives of the study, this method may involve a heavy reliance on engineering data, or engineering data may be used only to supplement and "rationalize" accounting record data.

Another consideration is the need or desire for innovation. If new methods are the goal, rather than improved organization with existing techniques, the most essential ingredient is an idea. To seek ideas systematically, we need an intimate knowledge of every process and operation. We need to ask: What is done? How is it done? Can it be done more cheaply or better? Is it necessary? Can the several different operations be better coordinated?

Many of the most successful innovators ask these questions intuitively. With such persons, change often comes by hunch or by accident. While engineers and economists should be on the alert for such fortuitous developments, their primary role in methods improvement involves the employment of systematic tools for job and process analysis and measurement, machine and process design, and cost analysis.

Engineering Methods for Estimating Physical Inputs and Costs

Whether research is designed to improve efficiency by developing innovations or by trying to organize existing or potential stage techniques better, numerous engineering tools will be found useful. These include the following:

Descriptive data regarding the nature of the process, the work methods used on individual jobs, and plant layout and process flow.

Work measurement studies, such as time and production studies, work sampling studies (frequently called ratio delay studies), and micromotion standard data.

Engineering estimates of nonlabor variable costs in which rates of input for such factors as electric power or fuel are based on direct measurement of inputs to operating equipment, or are synthesized from engineering reference data. This type of analysis may also lead to estimates of equipment capacity required in relation to rate of plant output.

Engineering estimates of the costs of durables to provide estimated

cost functions that are standardized from the standpoint of price level and as to quantities of physical plant required in relation to rate of output. These usually involve engineering estimates of current replacement costs for buildings and equipment, which form the basis for estimates of future expected average annual costs.

Stage and Plant Cost Functions

A key element in studies of plant efficiency is the development of cost functions for the separate plant stages. The first step is to develop standards of output and equipment requirements for each operational component. These standards are obtained by synthesizing the results of work measurement studies, by analyses of plant accounting records, or by joint analyses of these two types of data. With these standards, estimates of average annual fixed costs and of variable costs per hour are obtained for each stage component. The aggregate of the fixed and variable costs for each component operation yields a stage cost function that relates average annual fixed costs per year and variable costs per hour to rate of output.

Depending on the objectives of the study, the production standards used in developing stage cost functions may be designed to reflect either the average performance observed in the work measurement studies or an "efficiency standard" that exceeds the average observed rate of performance. An "efficiency standard" represents the level of sustained performance that could be expected under conditions of efficient operation, but not necessarily a peak observed rate. Its use is appropriate in determining the relative efficiency of different methods of performing the operations in a given plant stage or in the development of long-run cost curves. The use of an "average performance" criterion is appropriate in studies which may form the basis for margin or price regulation. This would apply, for example, to studies in administered-price markets of the costs of store delivery of milk in relation to volume per stop.

For a particular plant stage, the most economical method of operation with any rate of output can be ascertained simply by comparing stage cost functions for the various methods. The development of plant cost curves, however, may become relatively complex. This follows from the concept that a plant consists of numerous stages with the possibility of choice between several methods within each stage and with many possible combinations of stage methods to form numerous variations in plant organization.

The development of a long-run plant cost curve consists of finding the combination of stage methods at each rate of output that results in least total plant cost. In concept, this process of selection and aggregation is simple, but in practice it may be complicated by the possible interrela-

tions among stages and the discontinuities in the stage cost functions. In some instances, the technique of linear programming might be used to facilitate the selection of optimum combinations.

A sample result of synthesizing a long-run cost function for California pear packing plants is shown in Figures 1 and 2. Both diagrams give long-run season costs in relation to rate of output for a specified proportion of packed and cannery fruit and for different lengths of operating season. Figure 1 illustrates a step in developing the final long-run function. Because stage cost functions tend to be discontinuous, the total cost function also is discontinuous. This creates a practical problem in computing the total cost function. To avoid excessive calculations, costs in this example were computed for a series of discrete but closely spaced points. These are the points plotted in Figure 1. Smooth functions fitted to these points give a very close approximation to the actual discontinuous total cost function.

Similar computations were carried out for other proportions of packed and cannery fruit. Consistent relations were noted among these separate solutions which permitted the long-run total cost function to be represented by a single multivariable equation. A final mathematical approximation is given by the expression

$$C = 2{,}766 + 16H + 438V_p + 322V_C + 5.23V_pH + 1.56V_CH$$

where C is the total cost per season, H represents hours of operation per season, V_p is the rate of output of packed fruit per hour in 1,000 pounds, and V_C is the rate of output of packed and cannery fruit. The correlation coefficient for this regression is .99992.[1]

This function is represented in average terms in Figure 2 for a specified proportion of packed and cannery fruit and for several lengths of season. In this form, the curves suggest economies that may be associated with large-scale production. This is an important result of studies of internal plant efficiency and an essential component of studies of area and industry organization. Because these long-run costs were developed by synthesis of stage cost functions of specified technology, the long-run total cost curves for a given length of season indicate the optimum technical plant organization for each rate of output.

Evaluation

Engineering methods of work measurement and cost synthesis are useful tools in developing improved work methods for operational stages of

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[1] This coefficient relates to the correlation between the continuous mathematical function and the synthesized costs for selected rates of output, rather than to correlation between estimated and observed costs in actual plants.

marketing and in evaluating the efficiency of different methods of performing particular jobs.

The possibilities of cost reduction in existing plants by using economic-engineering techniques of analysis have been demonstrated in numerous studies by the agricultural experiment stations, the U. S. Department of Agriculture, and commercial enterprises. These techniques also provide data essential to the synthesis of long-run plant cost curves in the determination of economies of scale and in studies of area and industry efficiency.

A major disadvantage of these procedures, especially with plant processes that require much labor, is that data collection and analysis may have to be carried on in great detail and hence be time-consuming and costly. Several developments may be hoped for, however, that will help in this regard. These include:

1. Continued improvement in methods of work measurement and cost synthesis with good prospects of developing greater reliability of measurement and reducing study-time requirements and costs.
2. The development of "standard data" for typical plant jobs and for certain kinds of durables—for example, building construction costs—which can be made available as reference data for use in new studies thus reducing the time required for field data collection and analysis.

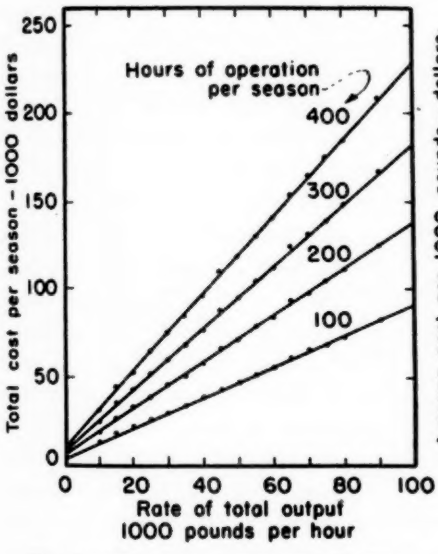

FIG. 1.—TOTAL COST PER SEASON (EXCLUDING MATERIALS) IN RELATION TO RATES OF TOTAL OUTPUT, ASSUMING THAT 80 PER CENT OF THE FRUIT IS PACKED.

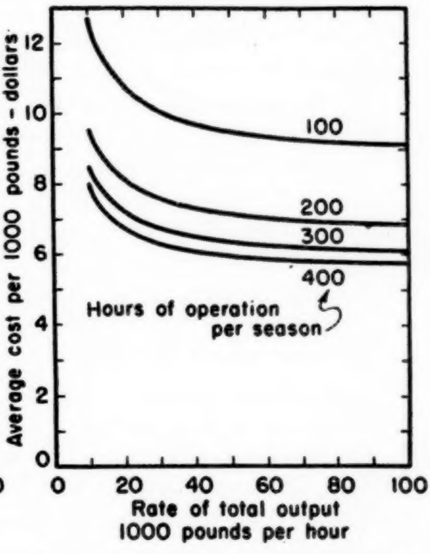

FIG. 2.—AVERAGE COST PER 1,000 POUNDS (EXCLUDING MATERIALS) IN RELATION TO RATES OF TOTAL OUTPUT, ASSUMING THAT 80 PER CENT OF THE FRUIT IS PACKED.

3. Effective use—in studies relying primarily on accounting records—of limited and strategic types of engineering data with the aim of better rationalization of accounting record data and improved prospects for analytical work based on accounting records.

Three fields of application for engineering in marketing research are evident. These include the direct participation of engineering in its traditional role of process analysis and process and machine design and development; joint work in process development and in studies of costs and efficiency by economists and engineers; and the borrowing of more readily adapted techniques of engineering analysis for use by economists in studies of marketing efficiency.

The best approach will depend on the problem, the available data, and objectives. Continued work in this field should result in a growing body of experience and data that will enhance the work of both economists and engineers in improving marketing efficiency.

ESTIMATION AND USE OF COST FUNCTIONS IN IOWA CREAMERIES*

HENRY A. HOMME
Iowa State College

ECONOMISTS have a long way to go in developing systems of economic analysis which are of direct policy usefulness to firms. The physical production data approach is difficult to apply directly since some inputs cannot be physically allocated to a specific factor, process or product. The accounting data approach is difficult since, not only does the allocating problem still remain, but the manager finds it all but impossible to infer from aggregated cost items to physical processes. This paper describes a system of integrating various disciplines and methods to provide Iowa creameries with cost information useful in future planning.

Studies Oriented to Investment Decisions

Some cost studies are oriented toward social policy actions, for example, an Iowa study comparing grain storage costs in commercial elevators with government-owned steel bins. The Iowa series underway on creamery costs is designed to assist firms in making individual decisions as to investment and output.[1] Such decisions will include not only changes in the number and size of plants in a multi-plant firm or in cooperative associations, but also managerial decisions as to appropriate combinations of resources to produce a given output. In a sense the purpose of this type of study is to transfer knowledge from the efficient firms and managers to inefficient and prospective firms and managers. This paper describes methods of estimating production coefficients and factor costs in studies of this type (i.e., where the orientation is to firm decisions) which may be different methods than are desirable for interfirm evaluation.

For investment planning purposes, the relationships of inputs to output must be translated into cost functions by the application of factor prices. Some of the components of the cost function do not lend themselves to physical analysis and can be kept isolated. The use of production functions in the Iowa creamery studies has been limited to the behavior of output as factors are applied to certain *key* machines, buildings, and labor. Costs obtained by applying prices to the factors thus provide only *partial* unit costs of intermediate processes. To obtain the *full* unit cost of processing milk or cream, some costs obtained from accounting records are added to those obtained by physical input-output data. The two

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* Journal paper No. J-2404 of the Iowa Agricultural Experiment Station, Ames, Iowa, Project 1169.

[1] See Frazer, Nielsen and Nord, "The Cost of Manufacturing Butter," Iowa Research Bulletin 389, 1952. Others in the series are not yet published.

methods of arriving at cost functions (i.e., from physical production data and from accounting records) are synthesized to build up unit cost estimates which appear relevant in planning for a future production period. In this sense the Iowa studies of creamery costs may differ somewhat in purpose from econometric studies designed to show economic behavior in a past period.

The orientation toward investment decisions is further emphasized by the choice of methods for obtaining the physical production data and cost factors. A team consisting of an industrial engineer, a dairy plant specialist, and an economist estimate, on the basis of observations, engineering data, and their knowledge of the industry, the production coefficients and prices which are likely to prevail in the future for a number of bundles of resource inputs. This team is typical of modern committee management. While this system may lack rigor in that no two investigative teams will come to exactly the same conclusion, it does arrive at a determinate solution which is useful to firms contemplating change.

The orientation toward future firm investment decisions has several significant connotations:

1. Observations of productivity of equipment, buildings and labor must involve the most efficient techniques available to a firm. Random sampling of plants does not provide an efficient method of selecting observations, since randomness provides an average productivity which would be exceeded by a new plant. The newest technology is not that in operation but that which is still on the drawing board. The productivity of these newest techniques of plant layout, building design, equipment and labor organization must be estimated by engineering data. Engineering estimates of productivity offer a beginning point in the calculation of factor-product characteristics of equipment, but engineering estimates must be checked to determine the extent of the "safety" factor, the extent of the bias introduced to promote sales, and the differential involved between productivity in the laboratory or pilot plant, and a commercial enterprise. The choice of plants in which to observe these discrepancies is made by judgment sampling by the investigators. Plants are chosen by the investigators on the basis of such criteria as standard of cleanliness and quality control, the nature of the equipment, building and labor, and the quality of management—all judgment criteria related to the investigator's knowledge of the industry. This process provides a number of plants in which important sources of variation have been held to a minimum, by choosing plants in which extraneous variables do not exist, exist to only a small degree, or are similar for all plants.

2. Estimation of obsolescence rates for buildings and equipment are required as well as estimates of depreciation due to time and deprecia-

tion due to use. It is very difficult to revalue existing facilities. In the study of butter processing costs, it was assumed that new facilities would be required, and thus replacement costs were made the relevant valuation. Obsolescence has been slow in the butter industry for many years, so little obsolescence was assumed. In estimating costs of spray dryers, however, rapid obsolescence was assumed.

3. Factor and product price estimates and estimates of institutional restraints must be realistic. Food processing firms often purchase factors in imperfectly competitive markets, which must be considered in applying prices to factors. Institutional restraints also, such as willingness of labor to work overtime, on Sunday, at different speed levels, and labor's attitude toward leisure, must be evaluated as they provide limitations on the use of labor. The economic horizon of the firm is often much shorter than the physical life of the production factors. In such cases, the discounted value of future returns is diminished. This logic must be made apparent through the use of higher interest rates than are current in the community.

4. Results must be simply stated, without requiring an impossible maximization problem before policy action can be recommended to the firm.

5. The concern of such a study is not specifically to develop new methods. The criterion is usefulness in planning for firms.

The Study Technique

For our dairy plant studies we have, as mentioned earlier, adopted a system of estimating physical production data which utilizes a three man team composed of an industrial engineer, a dairy plant specialist and an economist. This team peruses the available engineering data—on machinery, for example—selects a number of plants in which the operation of the machinery can be observed and uses these observations to modify the engineering estimates of productivity. Labor-time standards are computed for specific operations from a study of machine speeds and from time and motion studies. A combination of factors is then chosen which appears to be efficient, and an attempt made to measure changes in productivity over a narrow range as the combination is varied. The investigators made many rough intermediate maximizing decisions in order to arrive at specific combinations of resources.

This technique provides a number of bundles of resource inputs which, when prices are applied, establishes a number of points on an outlay surface. These planning points are chosen with reference to units of a significant indivisible factor. The choice of specific points on the outlay surface required the judgment of the research team. The significant factor in a butter processing cost study was churnings per day, essentially a labor phenomena attached to a large piece of equipment.

In the butter processing study, the choice of churnings as a major indivisibility led to synthesized costs for creameries of the following sizes:

Pounds Butter Manufactured per Year	Cost per pound of butter
360,000	4.77
720,000	3.52
1,080,000	3.56
1,440,000	3.55
2,160,000	3.26
2,880,000	2.96

Cream supplies limit the firm's discretion as to output in Iowa creameries, since Iowa's 400 creameries historically do not compete actively for cream supplies. The most important planning decision open to Iowa's 250 cooperative creameries is consolidation, since this is the most effective method of increasing volume. The average butter volume manufactured in Iowa cooperative plants is 390,000 pounds per year, thus the selected planning points (in multiples of 360,000 lbs. per year, or one churning per day) are fairly consistent with volumes which may be encountered by cooperatives considering consolidation.

Buttermilk Drying Costs

Following this study, an investigation was made of buttermilk drying costs as an auxiliary enterprise marginal to butter processing. Four sizes of plant were chosen and unit costs computed for each size of plant.

Volume of Butter Manuf. Annually (pounds)	Cost per Pound to Manufacture Buttermilk Powder (cents)
550,000	7.43
850,000	5.19
1,250,000	4.55
1,430,000	4.03

The key machine in drying buttermilk is the atmospheric roll dryer. Cost functions were built up of categories of costs bracketed according to the degree to which they were fixed. Building, equipment and boiler costs were considered as fixed costs to which a depreciation and obsolescence rate was applied over several accounting periods. Labor was considered a semi-fixed cost contracted for a year in advance. Fuel, electricity and packaging comprised the third category. Engineering estimates were used to determine fuel costs by an application of the formula:

$$c = \frac{\left[\frac{100}{a}(100) - (100)\right](b + d)}{(.93)(.65)(e)}(f)$$

in which c is the fuel cost for producing 100 pounds of dry buttermilk powder, and;

a = 8.7 = per cent solids in fluid buttermilk
b = 895 = latent heat of vaporization at the steam pressure used
d = 150 = B.T.U.'s required to raise 100 pounds of fluid buttermilk from the original temperature to 212 degrees F. (this assumes the specific heat of buttermilk to be one)
.93 = dryer efficiency
.65 = boiler efficiency
e = 11,500 = B.T.U.'s in one pound of coal
f = .45 cents per pound = standard price per pound of coal

This formula provides fuel costs which vary directly with output. The fixed nature of labor and equipment costs (fixed as soon as the decision to invest in and operate the plant has been made)[2] provides cost curves which reduce sharply as output increases. These fixed costs represent about 65% of unit costs at the low volume and 55% at the large volume. The policy question involved was whether it would pay creameries to dry the buttermilk, a decision which, given the cost function, depends on the price of buttermilk powder and the revenue from alternative disposal procedures.

The study of buttermilk drying was much more of the engineering approach as used by Chenery and Ferguson[3] than the butter processing study since rather stringent physical laws of thermodynamics set limits to the process. The application of labor in both studies was, however, conditioned very largely by institutional factors. Both studies presumed a major limiting raw material—cream, and a single product, and thus the problem was one of minimizing cost rather than of maximizing returns.

Fluid Milk Alternatives

It has been noted that consideration of any change in physical plant in Iowa creameries, however, invariably brings up the question of whether or not to invest in facilities to receive fluid milk rather than cream and in consequence, a maximizing decision as to how much of each of several alternative processes to engage in and which and how much of several products to produce. Before a maximization problem can be solved, either a single equation problem or a simultaneous equations problem, the input-output coefficients for all relevant processes must be established. Since buildings, equipment and labor for such a multiple-product plant

[2] From a planning point of view, the activity of buttermilk drying is essentially a package of fixed production inputs. Whenever the number of these activities becomes too large to analyze verbally, a technique such as linear programming seems to be well adapted to its analysis.

[3] Hollis B. Chenery, "Engineering Production Functions," *Quarterly Journal of Economics*, Vol. 43: pp. 507-537, Nov., 1949; and A. R. Ferguson, "Empirical Determination of A Multi-dimensional Cost Function," *Econometrica*, Vol. 18, No. 3: pp. 217-235, July, 1950.

are available in discrete sizes, and since synthesizing provides a discrete number of resource bundles to evaluate, activity analysis may be appropriate as a maximizing technique.

We are presently engaged in fixing production coefficients for the milk receiving operations and the skimmilk drying operation. The milk receiving operation is approached similarly to procedures used by French at Purdue and Hall at Michigan State.[4] In the initial planning period, labor appears to be a major indivisibility in receiving operations, in that the layout is designed for a one man, two man, or three man operation. Time standards of 5 cans per minute for a one man operation, 8 cans for 2 men, and 10 cans for 3 men appear to be feasible planning standards, incorporating small "safety" factors. These standards are modified by building and flow designs, number of cans per producer which determine the number of weighing operations, the operations related to quality, can washer speed, pump capacity, valve-dumping speed and other variables. The estimation of milk volume to be received during a specific time interval determines the speed with which the line must run, this in turn fixes the labor requirement, which fixes the design of the receiving line and the equipment required. The cleaning time varies with the quality of the product, the tastes of the manager, and the efficiency of the worker, and this time was roughly standardized through the selection of plants for observation.

The productivity of skimmilk spray dryers is difficult to estimate because of rapid technological advance. The engineering estimates have considerable variance and some models have never been tested in a social setting. A few years ago small size dryers were not available at all. In the initial planning period, labor may be a more significant indivisibility than the dryer and accessory evaporating equipment.

Summary

Our approach to cost studies in Iowa creameries can perhaps be described as a modified engineering approach. In the anticipation of investment, the most modern techniques are applicable. Engineering estimates are often the best productivity index available. As soon as possible these estimates are modified by observations in pilot plants or in plants selected as typical of those who will take policy action. The function of the team of industrial engineer, economist and dairy plant specialist is to make the adjustments. The team also assigns to the factors and, in a maximization problem, to the products, prices which appear in line with present prices

[4] Charles E. French, *Research Procedure in Evaluating Milk Receiving Labor in Indiana,* Indiana Bulletin 575, January, 1952.

Carl W. Hall, "Efficiency of Labor and Equipment in the Receiving Room," *The Circle,* published by Cherry-Burrell Corp., May-June, 1953.

and with price trends. Team decisions involve compromise and reduced bias. It is consistent with modern committee management. The resulting cost figures, representing only a limited number of points on the outlay surface, provide significant planning points of a number not too great for assimilation by capable managers. These discrete points may be within reasonable planning error of any likely planned output and input combination.

It can be seen that the team approach utilizes econometric procedures wherever data is available and such methods appear applicable, as in such areas as the development of labor standards, inputs of fuel, machine speeds, and uses a built-in team-compromise system of estimating other inputs and their effect on cost and output. Such estimates are oriented to investment policy, which may be contradictory to dividend policy, growth policy, tax policy, etc. Many of the estimates are judgments of the team, which implies that other teams may reach somewhat different conclusions. The necessity for judgment is created by the inadequacy of available econometric methods in quantifying much empirical data.

CURRENT RESEARCH IN FARM MANAGEMENT

Chairman: J. A. Hopkin, University of Wyoming

USE OF PRODUCTION FUNCTIONS IN FARM MANAGEMENT RESEARCH

DONALD B. IBACH*
Bureau of Agricultural Economics

MUCH has been written about the problem of finding and describing input-output relationships. The basic problem of course is to obtain reliable information, applicable to substantial areas of production, as to the effect of different combinations of inputs on yields and production. A lot of rehearsals have been conducted in the use of different tools in the field of production functions. As the outlook for more suitable basic information appears favorable, perhaps in the future more effort can be devoted to the job of preparing and presenting answers to the problems themselves. These answers, in the form of economic interpretation, need to be more readily understood not only by researchers, but by extension workers, by farmers and by those who supply farmers with many of the inputs used in modern farming. Making them understood by those on the production lines is a job that merits attention by the research worker.

In doing these things we need to establish a working partnership with the natural scientists—from planning of the work that is to provide the basic information, on through the analysis and presentation of the material. We need to be a little like the student who was asked to describe from beginning to end the process of demonstrating osmosis through use of a section of pig's bladder. He said that the first thing to do was to kill a hog. That was getting right back to basic materials. We who are to make economic interpretation need to have more than just a casual acquaintance with the basic material.

Yield Data and Yield Functions Used

For illustrative purposes I am presenting some types of answers obtained through use of production functions as applied to the problem of fertilizer economics. But, as it was suggested that methodological issues be emphasized, more time and space will be devoted to them than to the end products. Certain comparisons are made of results obtained from use of four different yield functions. Three of these are applied to a single variable experiment including 5 levels of a 4-8-7 fertilizer on potatoes in

* Assistance in preparing some of the materials used in this paper was rendered by S. W. Mendum, BAE.

Maine. Two of the three yield functions are similar in that one (a modified exponential) postulates a constant rate of change in *increments of* output with *equal* changes in input, whereas the other (Cobb-Douglas) postulates a constant percentage change in *total* output with each *percentage* change in input. The third function used in connection with the potato experiment is the ordinary polynomial parabola with which most of us are familiar.

One of the other two functions used in this experiment was developed independently by Mitscherlich in Germany and by Spillman in the United States. Its hypothesis is that as fertilizer is added in units of uniform size, successive increments in yield diminish at a constant rate. The yield at each rate is calculated as a percentage of a theoretical maximum yield. The form of this equation as used here is $y = M(1-R^x)$ in which y is the calculated yield, and R is a constant less than 1.0 whose numerical value expresses the ratio of each increment in yield to the one that precedes it. The independent variable, x, as used here represents a single plant nutrient. As will be illustrated later, it consists of two parts, the applied portion and the calculated quantity in the soil. M is the theoretical maximum yield attainable from fertilizer under conditions of the experiment.

In using this equation, or its equivalent, Mitscherlich holds the view that for a given size of unit of application, the value of R is the same for a given growth factor for all crops. This view is not a necessary part of the general hypothesis, and Spillman did not regard it as such. As we are using it as one equation in analyzing fertilizer experiments, R takes whatever value is indicated by the reported data. It is a modified exponential equation, but for purposes of this paper, it will be referred to subsequently as the exponential function or equation. As the items of economic interpretation to be presented later are based on this equation, more attention is given to procedures in using it than to procedures in using the other equations.

A second equation used in part of this analysis is $y = ax^b$, popularly referred to as the Cobb-Douglas function. In this, b is a fixed exponent of x, the variable. This is in contrast to the equation just described, in which x, the variable consisting of two parts as pointed out earlier, is the exponent of the constant R. In the Cobb-Douglas function there is no theoretical ceiling beyond which yields may not rise. These two functions, and the polynomial parabola are compared in connection with the potato yield data mentioned above.

Data from another experiment are used for purposes of additional comparisons of yield functions. This is a 4x3x3 factorial in a pasture fertilizer experiment in Texas. It includes 4 rates of N, 3 of P_2O_5 and 3 of K_2O. Each of the 36 treatment combinations was replicated four times, making

a total of 144 plots. Analysis of variance of logarithms of the yields showed that all of the main effects were significant, but the yield response to the levels of N used in the experiment was generally greater than to the levels of P and K used. None of the interactions was significant. The standard error of the yields reported for all replicated plots was 480 pounds of dry forage per acre, or about 10 percent of the average yield for all the plots. Data of this experiment are used in comparing results obtained from applying the exponential function, $y = M(1-R^x)$, and from using analysis of variance to estimate yields.

The polynomial parabola and the Cobb-Douglas functions were not used in connection with the pasture data, for reasons that will be discussed when comparing the different functions applied to the potato fertilizer experiment. Rates of application of N, particularly, in the pasture experiment were not carried to high enough levels to provide a good basis for characterizing the response curve. The parabola in particular, and the Cobb-Douglas function to a lesser degree, have less basis for use in extrapolation, than does the exponential function as developed by Mitscherlich and Spillman.

Comparison of Yield Functions—One Independent Variable

Figure 1 shows the reported yields for the Maine potato fertilizer experiment, and the response curves resulting from use of three functions, the exponential, the Cobb-Douglas and the polynomial parabola. The sums of squared deviations as calculated from reported yields for these three functions are, in the order named above, 53 bushels, 143 bushels, and 1,025 bushels. Also, in the same order, the standard errors of estimate are 5 bushels, 7, and 18 bushels.

Constants of all three equations were developed by the method of least squares. In the Cobb-Douglas function, as logarithms of the yields form a straight line when plotted against logarithms of the fertilizer applications, a least squares fit is easily accomplished by the equation $y = a + bx$ applied to the logarithms. But a principal advantage of this function lies in the ease of obtaining an approximation to least squares by drawing a straight line to approximate best fit to the plotted logarithms. A simple method of graphic approximation to least squares, using the exponential function, will be illustrated later.

As is the case when using the exponential equation, x in the Cobb-Douglas equation represents the total quantity of the input, in this case soil content plus applied portion. Thus in using the Cobb-Douglas function, as there is no logarithm for zero application two courses are open: (1) plot the logs of reported yields against logs of other applications and by process of trial and error find an estimated quantity for soil con-

tent such that the logs of applications plus soil content when plotted against logs of the yields will fall on a straight line; or (2) use a very low application such as one pound as equivalent to no application and plot the log of that low x value against the log of the yield reported at the no application level. The former is theoretically a more sound procedure, but the latter, sometimes used, will often produce substantially equivalent results. Results obtained by the two methods will be more nearly similar

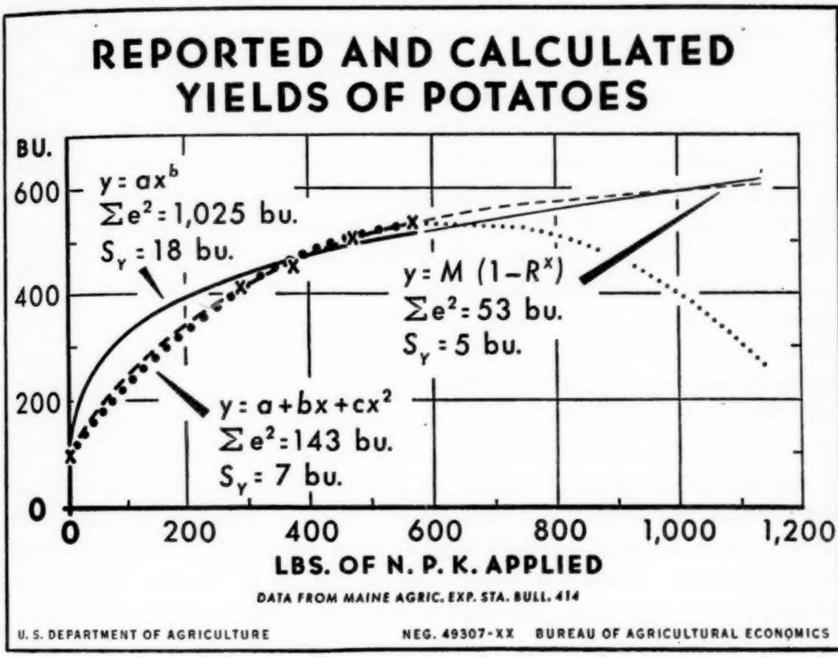

FIGURE 1

when soil content of the input variable is extremely low, than when soil content is high.

Often fertilizer experiments do not carry enough rates to permit characterization of the entire range in response. However, many Maine potato growers are obtaining increasing yields through such a range as indicated by the estimates extrapolated in figure 1, using either the exponential or the Cobb-Douglas equations. The highest rate applied in the experiment was 570 pounds of plant nutrients. Clearly, the polynomial parabola is not suited for extrapolation. The exponential function has a theoretical advantage over the Cobb-Douglas function. The latter establishes no maximum, hence calculated yields continue to rise with every estimated increase in fertilizers applied.

Yields calculated by different functions may differ only slightly within

a portion of the range in response. A straight line may appear to fit the data for a short segment of the range, even when the function is distinctly curvilinear. Perhaps the straight line function has often been used when the relationship is nonlinear, partly because tests for goodness of fit can more readily be applied to it to determine whether any other function would fit as well. Probably another reason for its use is that the range of observed response is often so limited that a straight line produces substantially as good a fit within that range as would be obtained by use of a curvilinear function. However, these reasons do not justify avoiding use of curvilinear functions when the observed relationship over a reasonable range in response is obviously nonlinear. As such is the case with fertilizer and crop yields we need not be concerned with a linear function.

The usefulness of a yield function is determined by the way it performs throughout the range in which response has major economic importance. The fact that one function may describe response a little more accurately than another for a part of the range does not necessarily mean that it is to be preferred for the whole. Some other function that fits the data almost as well might be chosen, if it has other advantages such as reliability for purposes of extrapolation, or ease in handling when two or more input variables are involved. There is a good deal of inherent error in most fertilizer rate experiments. For example, an experiment carrying several replicates of each treatment is rated as good if the standard error of the individual plots is within 10 percent of the average yield of all plots. Then the element of uncertainty as to recurrence of other conditions, such as weather that would affect response if the experiment were repeated, makes pin point accuracy of fit at certain input levels subordinate to the main job—that of economic intrepretation.

Use of Yield Functions in Analyzing Factorial Experiments

Part of the data from the Texas pasture experiment referred to earlier is shown in Table 1. This part includes the eight different treatment combinations used in developing constants of the exponential equation as applied to each nutrient curve. Reported yields are shown with each of the three nutrients varying at specified levels of the other two. Yields for all 36 treatment combinations are shown later in comparing reported yields with yields calculated by the exponential and the analysis of variance equations.

The Exponential Equation—Finding Constants

Graphic methods are used in finding constants of this equation. In this method, the data are plotted and a smooth curve is drawn free-hand to approximate as close a fit as possible. Three points are located on

TABLE 1. REPORTED YIELDS OF DRY FORAGE PER ACRE AT STATED TREATMENT COMBINATIONS

Plant nutrients applied			Reported yield[b]
N	P[a]	K[b]	
Pounds	*Pounds*	*Pounds*	*Pounds*
0	240	0	2,339
(60)	(240)	(0)	(4,070)
120	240	0	5,688
180	240	0	6,971
60	0	0	2,860
60	120	0	3,963
(60)	(240)	(0)	(4,070)
(60)	(240)	(0)	(4,070)
60	240	60	4,561
60	240	120	4,874

[a] P and K are used to denote P_2O_5 and K_2O, respectively.
[b] Mean yield of 4 replicate plots. Parentheses indicate combinations occurring in each series.
Pasture experiment, Kirbyville, Texas, Texas Agricultural Experiment Station, 1950.

this curve, usually (but not necessarily) those associated with the lowest and highest rates of application, and a mid-point. Steps in the process as applied to the N series in Table 1 are indicated below. The mid-point read from the curve is associated with a 90 pound application per acre, a rate not included in the experiment.[1]

1.

x		Y	i	R	1-R
Pounds	Graphic units	Pounds	Increments in Y	(i_2/i)	
0	0	2,339	—		
(90)	1	(4,848)	2,509		
180	2	6,971	2,123	.84615	.15385

2. A, the increase in Y attainable from fertilizer, a value used in obtaining M. Calculation: $i/1-R$ or $2{,}509/.15385 = 16{,}308$ pounds; thus $M = A + Y$ or 18,647 pounds, or 9.3235 tons.
3. u, size of unit required to render R a specified value. This is for simplifying later computations. The value, 0.8 for R has been chosen arbitrarily. Calculation: $\log 0.8/\log R = -.09691/-.07256 = 1.336$ 90 pound units, or 120.24 pounds. The term unit as used subsequently in connection with the analysis, refers to this item.
4. n, the calculated soil content of the variable N. Calculation: $(\text{Log } M - \log A)/\log 0.8$, or 0.6007 units.
5. a, the applied portion of N in terms of units, or pounds applied/u.

[1] For detailed exposition of procedures for various phases of analysis based on this function see D. B. Ibach and S. W. Mendum. "Determining Profitable Use of Fertilizers," USDA, BAE processed report, F.M. 105, June 1953.

6. The number of units of n + a for any rate of a is located in a table of 1-R^x values prepared on the basis of R = 0.8, and the corresponding 1−R value is read from the table. Then y = M $(1-R^{n+a})$. The letters p + b and k + c are used in handling the variables P and K, respectively.

When the theoretical maximum yield is calculated from constants that have necessarily been developed from reported yields covering only a portion of the range within which response would occur, it may reflect a quantity of output that departs substantially from the practical maximum yield. This is the situation for the N curve for which the calculations have just been shown. If rates up to perhaps 500 or more pounds had been applied, the constant, M, might have been substantially different from the 9.3 tons indicated. But this would not have affected materially the calculated yields, if the portion of the curve calculated from the 4 rates were appropriate for the new range of application. Changes in the constants R and M would have been accompanied by compensating changes in the size of unit of application associated with these constants. This means that constants developed from yields reported at the four rates applied, would be appropriate for calculating yields as long as response is obtained from additional fertilizer, if the response through the 4 rates correctly characterizes that portion of the total response curve. With the exponential equation, some extrapolation is valid, as is interpolation between rates, but unless rates are added until the shape of the curve becomes apparent, there is always a question as to the extent of additional response.

Certain qualifications are sometimes necessary in interpreting the results of use of this equation. The principal qualification is that at very low rates of application there may be in some experiments a phase during which increments in yield do not diminish, but actually seem to increase. When this occurs, a sigmoid curve would result in best fit at low rates of application. The number of, and intervals between, rates in the Texas pasture experiment do not permit a check on this point. This tendency toward increasing increments is not usually found under field conditions unless soil content of the variable nutrient is extremely low. Even though calculated yields may sometimes depart widely from reported yields at low rates on soils that are extremely low in fertility, this part of the curve has relatively little economic significance.

Three Variable Form of the Exponential Equation

The German mathematician Baule, working with the equation developed by Mitscherlich, pointed out that when two or more inputs are varied at the same time, the yield is a function of the product of their

individual effects. Thus, for the three variables N, P, and K used in the Texas pasture experiment, $y = M\ (1-R^{n+a})\ (1-R^{p+b})\ (1-R^{k+c})$. The value of M for more than one variable is derived by dividing the calculated yield at any point on either of the single nutrient curves, by the product of the $1\text{-}R^x$ values associated with that combination. The equation is reversed. Thus, $M = y/(1-R^{n+a})\ (1-R^{p+b})\ (1-R^{k+c})$. For purposes of economic analysis constants of each of the three single variables developed as indicated, were used in calculating yields for all combinations included in the experiment. Yields calculated in this manner are shown later in comparison with reported yields and yields estimated from analysis of variance.

Equations From Analysis of Variance[2]

If the input-output relationship is known to be generally curvilinear, it is more appropriate to use logarithms of yields when conducting analysis of variance rather than the natural numbers. Aside from this, use of logarithms in the analysis of variance has certain technical advantages in the event that interaction is significant. Often the nature of the interaction is such that it is not reflected in the logarithms and when this is true, yields may be estimated from analysis of variance much more readily than when such analysis is conducted with the natural numbers. Then, when yield estimates are desired from the analysis of variance, the logarithm of an estimated yield for a particular treatment is derived by simply adding logarithms of estimated effects of specified quantities of fertilizer. Thus, $\log y = M + N_i + P_j + K_k + R_l$ where M is the mean log yield over the entire experiment, N_i, P_j and K_k, the average responses of log yields to i pounds of N, j pounds of P and k pounds of K, and R_l is the average response of log yield to a particular replication as compared to other replicates. Yields for the different treatments in the Texas pasture experiment are estimated from the analysis of variance and are included in Table 2.

When estimating yields from analysis of variance equations no assumptions are made as to the nature of response to fertilizer, other than that it is generally curvilinear. Because of this freedom from specification the calculated yields arising from the analysis of variance usually conform more closely to the reported yields than those calculated from an equation that is based on a more specific hypothesis. That is, estimates made from analysis of variance reflect aberrations that may occur in the data. If there were no aberrations, so that reported yields all conformed to some general type of curve, yields calculated from the equation for that type of

[2] The analysis of variance equation and yields calculated therefrom (Table 2) were supplied by Glenn L. Burrows, Statistician, Office of Statistical Assistant, BAE.

TABLE 2. REPORTED YIELDS OF DRY FORAGE PER ACRE, AND YIELDS CALCULATED BY THE TWO EQUATIONS INDICATED

Treatment	Reported	Calculated		Treatment	Reported	Calculated	
	Y	Exponential[a]	Analysis of variance		Y	Exponential[a]	Analysis of variance
Pounds	*Pounds*	*Poinds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
0- 0- 0	2,029	1,900	1,808	120-120- 60	6,878	6,317	6,615
60- 0- 0	2,860	3,047	2,769	180-120- 60	8,204	7,900	7,854
120- 0- 0	3,959	4,138	3,912	0-240- 60	3,068	2,923	2,994
180- 0- 0	4,719	5,175	4,644	60-240- 60	4,561	4,686	4,584
0-120- 0	2,417	2,628	2,639	120-240- 60	6,372	6,364	6,476
60-120- 0	3,963	4,213	4,040	180-240- 60	7,267	7,959	7,690
120-120- 0	5,875	5,722	5,706	0- 0-120	2,144	2,217	2,168
180-120- 0	6,599	7,156	6,776	60- 0-120	3,272	3,554	3,320
0-240- 0	2,339	2,647	2,583	120- 0-120	4,962	4,827	4,690
60-240- 0	4,070	4,245	3,955	180- 0-120	4,888	6,036	5,569
120-240- 0	5,688	5,765	5,586	0-120-120	3,236	3,065	3,164
180-240- 0	6,971	7,209	6,633	60-120-120	4,568	4,914	4,844
0- 0-60	2,197	2,098	2,096	120-120-120	6,916	6,674	6,842
60- 0-60	3,402	3,364	3,210	180-120-120	8,786	8,346	8,124
120- 0-60	4,260	4,569	4,534	0-240-120	3,168	3,088	3,097
180- 0-60	5,213	5,713	5,384	60-240-120	4,874	4,951	4,742
0-120-60	3,120	2,901	3,058	120-240-120	6,337	6,724	6,698
60-120-60	4,658	4,651	4,683	180-240-120	8,892	8,408	7,954

[a] Yields for the 36 combinations were calculated from constants developed from 8 different treatments, varying N with P and K constant at 120 and 60 pounds; varying P with N and K constant at 60 and 60 pounds; and varying K with N and P constant at 60 and 120 pounds.
Pasture experiment, Kirbyville, Texas, Texas Agricultural Experiment Station, 1950.

curve would conform to reported yields as closely as those calculated from analysis of variance.

Analysis of variance can be used, however, to indicate which of different yield equations, or hypotheses, appear to be reflected by the reported yields. For example, an examination of the relationship between N_i (average response of log yield to i pounds of N), can be used as an index of the appropriateness of the exponential, the Cobb-Douglas, or some other equation. Thus, if the N_i increase equally with equal absolute increases in the quantity of N applied, the exponential equation is suitable. But, if the N_i increase equally with equal percentage increases in N applied, the Cobb-Douglas equation is suitable. Or, if neither is true, a modification of one or the other may be indicated. The nature of the modification may be such as to require essentially the exponential equation, or some variant of the Cobb-Douglas form.

Whatever the situation as to type of function that would best fit the data, if analysis of variance indicates that interaction is significant, its use as an estimating equation to calculate yields and as a basis for subsequent

economic interpretation, is much more laborious and time consuming than the multivariable form of the exponential equation as illustrated. Thus. the place of analysis of variance is to: (1) measure the relative importance of different yield influencing factors, (2) determine whether or not interaction between different measured input factors is significant, and (3) aid in selecting a yield function that appears to be appropriate for purposes of calculating yields and as a basis for subsequent economic analysis. However, in order to obtain accurate results from analysis of variance as a basis for practical decisions with respect to any of these three items, it is important that the experiment include enough rates of each input variable to permit characterization of the different response curves. Analysis of variance is not a substitute for inadequate data when the question is what to do about a problem—such as that of recommending most profitable rates of application of fertilizer.

Results from Different Functions Applied to the Texas Pasture Experiment

In the case of the exponential equation, the standard error of estimate of the yields calculated for all plots, from constants developed by graphic approximation from the yields of the 8 treatments shown earlier in Table 1, is 442 pounds. But for purposes of comparing yields calculated by the two yield functions indicated in Table 2, a different set of series combinations was used in finding constants of the exponential equation. This second set of series combinations used in developing the constants is indicated in the footnote to Table 2. The resulting standard error of estimate of the yields calculated for all 36 treatments from this set of 8 treatments is 391 pounds compared with 297 pounds for the analysis of variance equation. The difference between these two errors of estimate is less than 2 percent of the average of the reported yields for all plots. Reasons why the analysis of variance estimates should conform more closely to the reported yields than those based on a more specific hypothesis, have been presented earlier. In view of the relatively small difference in errors of estimate, and because of the greater adaptability of the exponential equation as a basis for economic analysis, the remainder of the discussion pertains to results obtained from that function.

As the single variable form of the exponential equation postulates a constant rate of decreasing increments throughout the range in which response occurs, the equation as used in calculating yields shown in Table 2 postulates a constant rate of interaction throughout this range. Interaction is defined as the difference between the response obtained when specified rates of different nutrients are added simultaneously, and the sum of the responses when the same quantities of these nutrients are added one at a time. Just as the single variable form results in a smooth curve rising at a decreasing rate throughout the area of response, the

multivariable form results in a smooth pattern of interaction.

If the exponential equation as used in calculating yields in Table 2 reflects the joint effects of simultaneously varying nutrients, deviations in calculated yields from reported yields, when the former are based on constants developed from different sets of series, should be at least roughly similar. In the case of the Texas pasture experiment, it has been pointed out that standard errors of estimate arising from use of this equation with two different sets of series, were 391 pounds in one case, and 442 in another. In a third trial, using another set of series as a basis for calculating yields for all plots, the standard error of estimate was 551 pounds. Thus the range in S_y resulting from use of the equation, was only 160 pounds of dry forage per acre, depending on the series used in finding constants for purposes of calculating yields for all treatments. This range in errors of estimate is only 3 percent of the average yield. The standard error of yields reported for replicate plots in the experiment is 480 pounds.

Economic Interpretation

Two items of major economic importance are presented, based on use of the 3 variable forms of the exponential equation as developed by Spillman. First, is the most profitable combination of nutrients and effects of changes in price-cost relationships; and second is the question of equal product combinations and marginal rates of substitution.

Most Profitable Combinations

Figure 2, which is largely self-explanatory, illustrates how the results of economic analysis can be prepared for popular presentation. Charts similar to figure 2 can be used to determine the most profitable combination of nutrients over any range in crop price-fertilizer cost relationship, as long as the cost ratio between the input variables is unchanged. Fertilizer costs per pound used in this analysis are \$0.195, \$0.096, and \$0.079 for N, P and K, respectively. Thus the relative costs of these nutrients per pound are 2.47, 1.22, and 1.0, in the order named above. In most areas farmers have different alternatives as to forms of materials to apply and the cost per pound of plant nutrients is sometimes quite different depending on the type of material used. This is particularly true in the case of N. It would, therefore, often be desirable to repeat the computations to reflect use of materials representing different nutrient cost ratios, and to prepare a chart similar to figure 2 for each cost ratio.

Monetary values per unit of the crop, instead of the crop value-fertilizer cost ratio, could be used as the vertical scale for figure 2, but this

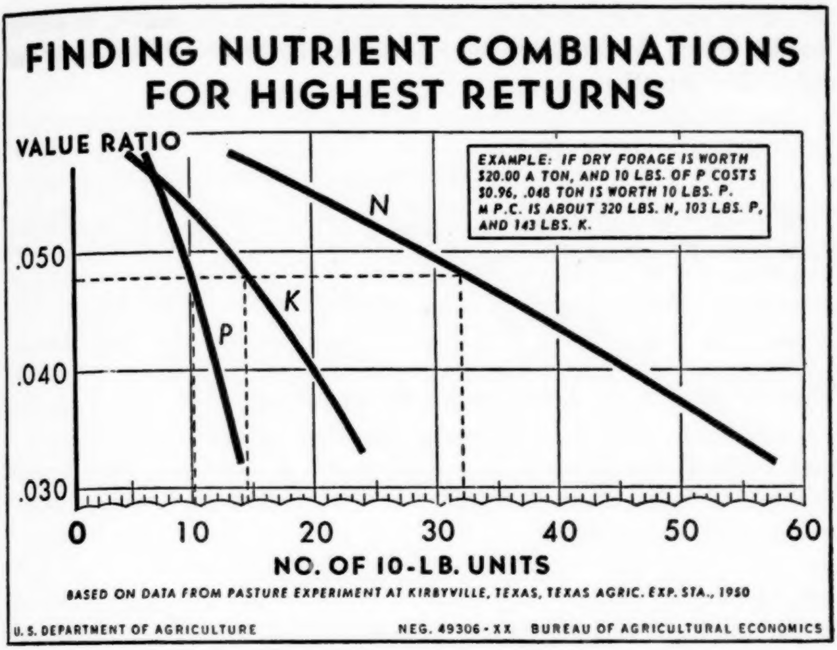

FIGURE 2

would reduce the flexibility of the chart. Farmers in important livestock producing areas are familiar with what is meant by the hog-corn ratio. Figure 2 is a pasture-fertilizer ratio chart. However, in some situations it may be desirable to sacrifice flexibility and prepare such charts in terms of dollar values per unit of the crop associated with a specified cost per pound of fertilizer.

The vertical scale of figure 2 is in terms of the quantity of crop equal in value to a specified quantity of one of the nutrients, 10 pounds of P in this instance. The computations are made in that manner and the most economical combination of N and K to use with specified rates of P, are derived. The calculations are repeated for a few rates of P covering a wide enough range to establish points for the curves.

All constants used in the yield equation have been defined and their derivation illustrated. A few new terms are introduced at this point. r', r'', and r''' are the costs per unit (u) of a, b, and c, respectively. For example, r' equals cost per pound of N times u as found in developing the N curve. T is a fraction used in calculating the value per unit of the crop, v, that would render the calculated combination the most profitable one. The work is arranged as a series of clerical steps that represent four equations

solved for each level of the specified nutrient, P, as illustrated. It will be recalled that a, b, and c are the applied portions of N, P, and K, in that order. The equations are:

$$1.\ R^{n+a} = \frac{r'R^{p+b}}{r'R^{p+b} + r''\ (1-R^{p+b})}$$

Thus $1-R^{n+a}$ is derived and the appropriate n + a value located in the table of $1-R^x$ values. Then a = n + a − n.

$$2.\ R^{k+c} = \frac{r'''R^{p+b}}{r'''R^{p+b} + r''(1-R^{p+b})}$$

Then $1-R^{k+c}$, k + c, and c are derived as above.

$$3.\ T = \frac{r''\ (1-R^{p+b})\cdot R^{p+b}(1-R^{p+b})}{[r'R^{p+b} + r''(1-R^{p+b})]\ [r'''R^{p+b} + r''\ (1-R^{p+b})]}$$

$$4.\ v = \frac{1}{M(-\ln 0.8)\ T}$$

the natural logarithm of .8 being the fraction −.223143. When the work is arranged with a separate column for each level of P, the calculations required to provide data for a chart like figure 2 can be carried out in two or three hours.

Equal Product Combinations and Rates of Substitution

Environmental conditions on a farm may place a lower limit on the yield that otherwise might be obtained through use of fertilizers. If different combinations that would result in obtaining the practical yield limit are known, the farmer may choose the least cost combination on the basis of existing input cost ratios.

It is recognized that basic physiological factors place some limits as to degree and period of time over which substitution of one plant nutrient for another may be made. There are many problems to be explored in this field. But the idea of substitution within some limits as to degree and time poses no problems not already present in situations where a crop is adversely affected by an unbalanced plant nutrient condition.

Rates of substitution—two input variables—The economic aspect of the problem is: How much of one nutrient substitutes for another at the lowest cost combination? Where only two input variables are involved, the answer to this question is easily obtained from constants previously defined and illustrated. For example, $(y/M)/1-R^{n+a} = 1-R^{p+b}$, where y is the specified yield desired. From the $1-R^x$ values of the two nutrients, the

quantities of the applied portions, (a and b), calculated to produce the specified yield are easily derived. The marginal rate of substitution of a for b in units is: $\frac{R^{p+b}}{R^{n+a}} \cdot \frac{1-R^{n+a}}{1-R^{p+b}}$ The answer to this expression times $\frac{u_a}{u_b}$ produces the marginal rate of substitution in pounds.

Using the above equations, it is calculated that in order to obtain a yield of 3 tons with applications of N and P at the no application level of K, a rate of substitution of 0.52 pound of N for 1 pound of P is associated with a combination of 160 and 65 pounds of these nutrients in the order named. Thus, when the cost per pound of P is about half the cost per pound of N, which is about the current situation, the least cost combination for the specified yield is the one indicated above.

A combination of 140 pounds of N and 159 pounds of P would also produce a yield of 3 tons. A farmer buying fertilizer to produce this yield might choose it because the cost per pound of available plant nutrients in a mixture containing these quantities is 3 cents less than in the current least cost combination mentioned above. This would appear to be a saving, because if 1 ton of the material bought contains 20 percent plant nutrients, or 400 pounds, the saving per ton would be 12 dollars. However, the cost per acre would be about $5.00 more. The response to N is very rapid in this range and the extra 20 pounds of N in the least cost combination more than offsets the additional cost per pound.

Least cost combinations—three input variables—Where three variables are involved, the problem is approached through assuming a number of different nutrient cost ratios representing a range wide enough to include any that are likely to occur. The lowest cost combination associated with each of these ratios is also easily calculated from previously developed constants. Interpolations may be made for other ratios if desired.

Assuming a specified yield of 5 tons where all three variables are involved, least cost combinations for four different nutrient cost ratios are shown in table 3, together with the cost of fertilizer per acre. A farmer may have the alternative of using some of the higher analysis nitrogen materials so that ratio number 2 would apply, in contrast with ratio number 1 which represents the more nearly average current situation. If so, he would lose substantially by not choosing such an alternative. There are forms of N available to some farmers who are equipped to use them that render cost ratio number 2 applicable.

Space has not permitted discussion of other uses of production functions and their application to broader problems related to management decisions and agricultural policy. Much good work has been done in this field. Also, progress is being made in the matter of collaboration with

TABLE 3. SELECTED NUTRIENT COST RATIOS, ASSOCIATED MINIMUM COST COMBINATIONS CALCULATED TO YIELD 5 TONS OF DRY FORAGE PER ACRE, AND FERTILIZER COSTS PER ACRE AT EACH COMBINATION

Ratio no.	Nutrient cost ratios (Relative costs per pound)			Least cost combinations			Total quantity of NPK	Fertilizer cost per acre[a]
	N	P	K	N	P	K		
				Pounds	*Pounds*	*Pounds*	*Pounds*	*Dollars*
1	2.47	1.22	1.0	269	103	120	492	71.85
2	1.85	1.22	1.0	287	81	94	462	57.18
3	1.25	1.22	1.0	353	68	62	483	46.32
4	1.25	1.00	1.0	325	78	65	468	43.32

[a] Based on estimated current cost of K of $0.079 per pound. Cost ratio 1 reflects approximately the current situation. Ratio no. 2 would reflect a 25 per cent reduction in the unit cost of N.

Pasture experiment, Kirbyville, Texas, 1950.

natural scientists in development of data that are more suitable for economic interpretation. The particular functions that have most to offer will establish their places as more information of the type needed becomes available. There is a long way to go in finding important input-output relationships and in using them to develop both better management on the individual farm, and general programs pointed toward more economic use of resources. In doing this we need to get our product packaged so that the consumer who needs it will take it.

RESEARCH INTO MANAGEMENT PROBLEMS OF CORPORATE FARMING

B. D. CROSSMON
University of Massachusetts

THE corporate structure of business enterprises in the United States has a growth closely paralleling that of industry itself. Over several generations, the benefits of incorporation have been of proven worth to business ventures, both large and small. Perhaps only agriculture has been slow in utilizing this institution. Here, too, exceptions can be pointed out, such as the corporate structure common among agricultural cooperatives. Also, many food processing and distributing firms are incorporated as are many of the industries offering direct services to farmers.

Farmers, in the main, have not seen fit to incorporate their producing enterprises. Taking my own State of Massachusetts, for example, and looking for farms in a list of the State's 40,000 corporations is like looking for the proverbial needle in the haystack. A plea to county agents for names of farm corporations has been largely fruitless. They listed a few, including the country estates of a few well-to-do industrialists, the tax-free farms of religious and educational institutions, the show windows of the city milk dealers whose advertisements feature their farms in the country, etc. Few commercial farm corporations appear.

Research is needed to determine whether the advantages of incorporation fit farmers' objectives. More specifically, information is needed on whether the change to corporate structure will fit farmers' pocketbooks with monetary returns exceeding monetary costs. Conditions favorable and unfavorable to corporate farming should be studied.

Changes which have an important bearing on this problem appear to be of two types: abrupt and gradual. Under the first I would list institutional changes in:

1. Social security laws
2. Tax laws; federal, state, and local
3. Liability laws
4. Credit programs of repayment and interest charges
5. Social ordinances, health, building, zoning, etc.

Gradual changes would include:

1. The trend toward fewer and larger commercial farms
2. The trend toward specialized farms
3. The increase in farm mechanization
4. The increase in output per acre or per livestock unit due to greater intensity in use of inputs, such as more fertilizer, improved feed and seed, etc.

5. A growing consciousness of profitable off-farm opportunities where labor and management returns are not restricted because of insufficient capital.

Items three and four under gradual changes result in a need for more and more operating capital for farming. Also, items one and three result in beginning farmers being unable to bridge the gap between capital available and that needed for operating a size of business which will support their families.

In developing research on possibilities of corporate farm firms, it is important to deal with the chosen objectives of farmers to maximize income and to maximize security. Because of uncertainty and risk, it must be recognized that farmers are rarely able to attain both objectives at the same time. To particular farmers the subjective balancing of increments of one against the other is necessary. Fuller knowledge of physical production ratios and probable prices and costs would help the farmer select and combine his resources. Institutional arrangements, often inflexible in nature, exercise considerable influence over the allocation of resources between farms and on a particular farm.

Possible Effect of Corporate Structure on the Family Farm

Our society's concern over allocation and control of resources has led to a fear that the application of the corporate structure to agriculture would destroy the revered "family farm." This socio-economic entity, meaning different things to different people, has become a catch-all of ends and means.

For research purposes the general definition of Ackerman and Harris[1] seems satisfactory. This definition has the farm family providing the management and most of the labor for operating the farm, although a moderate amount of labor hired from outside the family is allowed. Returns are such that the family can make a satisfactory living while maintaining the farm's productivity and assets. This definition seems to offer the flexibility needed to meet dynamic changes. W. K. McPherson[2] sees the family farm as "a dynamic organization whose form and usefulness is always changing." Zimmerman,[3] a sociologist, gives a broader definition held by many in society. To him, "A family farm is an organization of agriculture in which home, community, business, land, and domestic family are institutionalized into a living unit which seeks to perpetuate itself over many generations"

[1] Joseph Ackerman and Marshall Harris, Editors, *Farm Family Policy*, Univ. of Chicago Press, 1947.

[2] W. K. McPherson, "A Critical Appraisal of Family Farms as an Objective of Public Policy," *This Journal*, Aug., 1952.

[3] C. C. Zimmerman, "Family Farm," *Rural Sociology*, March, 1950.

Society's case for the place of the "family farm" in the community has been given strong emotional backing by the readers of John Steinbeck's *Grapes of Wrath* and Carey McWilliams, *Factories in the Field.* Goldschmidt's comparative analysis of the Arvin and Dinuba communities of the Central Valley of California has been challenging. Here were two communities quite similar in natural resources, but differing in size of farm and management. In one community relatively small family farms were dominant. In the other, large-scale units of land were under corporate management. Congress was aroused by this report[4] that community life was superior in the area containing the family farms.

The fear, expressed by many in our society, of the impacts of change on the family farm traditions is well expressed by Zimmerman[5] who sees:

1. "The family farm in the good farming districts is being replaced, not entirely, but in a major sense and rapidly, by corporate, capitalistic, and non-family forms of management in agriculture. These new forms of social organization differ in many respects in their relation to the social system from the family farms.
2. "The farm family particularly in the good agricultural regions is coming under new systems of control and management, which is leading to a flight from these regions of the independent and culturally stable people.
3. "The new organization of agriculture in the fertile districts is changing in its relation to the rest of society, so that in place of the former being *in and of* the society, it has become *in* and not *of*. It is becoming culturally independent and is seeking to go its own short-sighted way, in many respects to the detriment of the whole society.
4. "These conditions are making life in the cities and among the other social classes, particularly family life, very difficult. As a result, the city people and other classes are being forced to adapt themselves to individualistic and anti-social ends."

Traditions to Challenge

This last point of Zimmerman indicates that his primary concern is not with what is happening to the farm but to the family. This view is shared by many believers in the agrarian and democratic traditions associated with the family farm. The agrarian tradition is one of agricultural fundamentalism, or a belief that "goodness" in the sense of moral and social values has root in rural life and particularly in the family farm. The democratic tradition is a belief that widespread ownership of land in family farms is a prerequisite to giving a maximum number of people an equal interest in government and in total welfare. A. W. Griswold[6] challenges this tradition. He indicates that democracy has survived in Great Britain even though family farms are not dominant there. He comments: "Democ-

[4] "Small Business and the Community," U. S. Senate *Small Business Committee Report No. 13,* Dec., 1946.
[5] Op. cit., "Family Farm."
[6] A. W. Griswold, *Farming and Democracy,* Yale University Press, 1948.

racy did not spring full flowered from the soil—it has grown from men's minds and spirits in the commercial and industrial atmosphere of cities, as much as in the agrarian atmosphere of the country." Griswold feels that the family farm is not saving democracy, but democracy may save the family farm.

But values other than a romantic symbol or tradition should be the criteria for continued survival. Although agriculture is still the oustanding example of individual economic enterprise, it is no longer characterized by laissez faire Owner-operation of the family farm is no longer necessary. Many farmers prefer to lease land and farm buildings, making use of such capital as they have for operating purposes. Supporting the agrarian and democratic traditions[7] is a third, the claim for the efficiency of the family farm. This concerns the capacity of the family farm operator and his family to combine the productive resources of land, labor, capital, and management into an optimum producing unit. The production economist feels that this concept of efficiency can be measured in rather precise terms. The land economist, or welfare economist, views efficiency in another manner. His optima may be in terms of which pattern of farming contributes most to security, equity of income distribution, and stability of income for the family and towards the welfare of the community and nation. Rainer Schickele[8] has contrasted these two theories as:

I. Farm Family Theory of Tenure, and

II. Farm Business Theory of Tenure.

The first favors owner-operation of farms under the conditions set forth by Ackerman and Marshall earlier. Tenancy is tolerated only as a step toward ownership. The theory stresses distributive equity, security, and social status in the community. The family farm is believed to best serve the welfare of the community and nation.

A Theory for Corporate Farming

The farm business theory of tenure would not give farmers any preferential treatment as compared with non-agricultural producers. The dynamics of the economy would not be interfered with and, according to the ability of the manager, the farm might reach great size as to acres of land, amounts of capital, and number of laborers used. The same financial, organizational, and managerial privileges available to other businesses would apply to agriculture. Capital would be available from investors and equity financing would be possible Labor and management could be separate with the latter coming from landlords or professional farm man-

[7] These three traditions are dealt with at considerable length by Joe R. Motheral, "The Family Farm and Three Traditions," *This Journal*, Nov., 1951.

[8] Rainer Schickele, "Theories Concerning Land Tenure," *This Journal*, 1952 Proceedings Issue, beg. p. 735.

agers hired by equity owners. The large scale of farm operations commonly contemplated by this theory are not unknown. On the East Coast and in the South, the rapid expansion of the broiler industry had taken place under such conditions. Large scale corporate farms in cash crop areas of the West have been previously mentioned. Shade tobacco is produced in the Connecticut Valley almost entirely by large corporate structures. The cranberry industry centered in Massachusetts, but with other producing areas in New Jersey, Wisconsin, and on the West Coast, is dominated by corporate structures, either large scale farms or cooperatives managing bog acreage. Many other large-scale fruit and vegetable farms are incorporated with separate producing units in different areas or states.

Are Economies of Scale Different Between Large Scale and Family Farms?

Many proponents of family farms feel that this type of organization is highly efficient in production. There are others who feel there are further economies in larger-scale farming. Early farm management surveys have left the impression that returns increase as farms become larger. More recent studies would indicate these early differences were due to methods of sampling farms. Differences in earnings may be due more to managerial ability in combining proportions of resources than to size of farm. The more recent empirical studies tend to indicate constant or decreasing returns to scale. These studies have tried to keep the proportions of factors constant as scale of operations has been increased. There will, of course, be increased returns per unit of a given factor if its proportion in the combination becomes less as the rest of the productive combination increases in size. Heady[9] points out that "of all the possible forces which may give rise to cost advantages for large scale farms, internal physical economies growing out of proportionality relationships are most important." An example is given by machines which can be used for a few or many acres. Heady believes machinery can be substituted for labor on large farms and its use spread over many hours. On small farms labor rates may be lower or non-cash in nature, making substitution of machinery less desirable.

Bachman[10] has made an aggregative analysis of the 1950 census data to determine whether large-scale farms are threatening a "possible breakdown of family farms." Technological changes have made it possible for "full-time" operators to manage larger businesses. Therefore, fewer farms are needed. Bachman estimates a drop in number of commercial farms

[9] Earl Heady, "Technical Scale Relationships and Farm Size Policy," *The Southern Economic Journal*, Jan., 1953.

[10] Kenneth Bachman, "Changes in Scale in Commercial Farming and Their Implications," *This Journal*, May, 1952.

from 5.3 million in 1930 to 3.7 million in 1950. He shows 25 thousand more farms with 1000 acres or more in 1950 than in 1930. But when an adjustment is made for the increased output per unit of labor, the value of products from these large farms, in terms of a common price level, is less in 1950 than in 1930. He feels that large-scale operators have substituted capital for labor, rather than increased size of business. The big increase in acreage and output has come in the middle groups of commercial farms. Here both land and capital have been added to the relatively fixed farm family labor supply.

Projections of Possibilities for Corporate Farming

Corporate structure in agriculture has been aligned with large scale farming. This need not be true. Most advantages of incorporation can apply to commercial family farms. Greater security of tenure and extended life of the farm can be assured through incorporation. Limited liability of the operator and other members of the farm firm are available via incorporation. Other aspects of incorporation need to be studied as they would apply to selected case farms operating under particular sets of conditions

Costs of incorporating most commercial farms need not be great. In Massachusetts a minimum fee of $50 will cover capital stock issue up to $100,000. An annual certificate of condition must be accompanied by a $15 fee. A similar fee is charged for amendments in corporate structure or stock changes.

Taxation of corporations varies considerably among states and communities. In Massachusetts there are several alternatives which the State may use in taxing a corporation. Net income is a likely base, but where all earnings are distributed to stockholders, other bases, such as gross assets and net worth, may be considered. Local communities normally tax real estate and motor vehicles. Corporations with part of their assets used for manufacturing may be exempt from local taxes on the manufacturing facilities. The State makes an excise tax charge on these manufacturing assets which is commonly less than the local property tax would be. For example, corporate farms producing and selling milk may have the processing facilities classified as manufacturing. How far this classification can be extended apparently depends on the discretion of the Massachusetts Department of Corporations and Taxation.

Federal tax programs on corporations are quite involved. Internal Revenue personnel want examples of capital gains and operating incomes of farm corporations before indicating what rates apply. Up to $25,000 of net corporate income, the 1952 rate applicable was a 30% normal tax.

Above $25,000 net corporation income there is an additional surtax. Many farm corporations will prefer to distribute the bulk of their earnings as salaries to the manager and other officers. Wide fluctuations from what the Bureau of Internal Revenue considers a reasonable salary will not be allowed. Certainly some examples should be worked out with the cooperation of the Bureau to indicate whether the higher surtax brackets for individual officers of the corporation might be avoided with the payment of more corporation income tax. The use of the corporate device to continue the life of a farm and to transfer ownership from one generation to another needs study. Harold Ellis of the BAE, who has the advantage of being a lawyer, as well as an economist, is studying these transfer aspects, the taxes and other costs involved with gifts, inheritance, capital stock transfers, etc.

The possibilities of the corporation in securing capital from non-farm sources and for equity financing need to be explored. Bachman[11] writes: "Perhaps the greatest potential danger of instability in income arises because of the increased capital requirements in modern farming that occur with increased sizes of farms and increases in machinery and other types of capital required. Investments averaging above $30,000 per farm commonly are required for operation of the medium and larger commercial farms in the United States. This represents more than a lifetime of saving for the average individual." Studies of the marginal efficiencies of capital in different size farm organizations may be of some help. Limited evidence to date among small family corporations indicates that the principal stockholder has to sign a note along with the corporation in securing capital. So, in some instances, management is not separate from capital in terms of financial responsibility.

Security Aspects of Incorporation

Operating security from one generation to another may be accomplished by incorporation. Inclusion under the Social Security system and eligibility for old age assistance is established where a farm operator becomes a corporation employee.

The Social Security Act was amended in 1950 to include agricultural workers. Although many self-employed were included at that time, farm operators were not. Legislative efforts to bring all farmers under the Social Security system have not borne fruit. The demand for such a program does not have the unanimous support of all farmers. Some object to this form of proposed regimentation and the red tape of reporting and

[11] *Idem.*

paying taxes. Other farmers may object on the same grounds as members of professional groups which preferred to be excluded High salaried professional workers have criticized the Federal Security program as being only a partial one applying to a limit of $300 a month of earnings or $3,600 a year. They also claim an inequitable distribution of returns to the fully insured at age 65. At present these are 55% on the first $100 of average monthly earnings and 15% on the balance, indicating a maximum of $85 a month for a particular individual. Having a wife over 65 years adds 50% to the benefits, or a maximum of $127.50 a month. Where there are children under 18 years, regardless of the age of the wife, maximum family benefits may reach $168.75 per month.

It is understandable that young professional workers who anticipate much higher average earnings than $3,600 a year over their working lifetime may object to the provisions of the Act. But older people when fully insured can tap an annual annuity with only a minimum of cost. The minimum period of payments to be fully insured is 6 quarters or one and one-half years. This applies to workers who were 62 years or older during the first half of 1951. Those retiring at age 65 in 1956, for example, would have to have coverage for at least one-half the quarters since January 1, 1951, or 10 quarters. Forty quarters of coverage fully insure any individual regardless of age.

An actual case[12] where the farm was incorporated to give social security to the operator and principal owner can be described. The lawyer who formed the corporation to include several members of a family writes as follows:

". . . we placed the father as president of the corporation, an employee, and therefore, under covered employment. We were able to establish a salary for the father of $300 a month, the maximum allowable under the law. After six quarters employment as a corporation officer, the father became qualified for his pension of $85 a month, the maximum now allowed under the regulations and as soon as the mother reaches 65 she will receive an additional $42.50, thereby making the total pension receivable of $127.50.

"The expense of constructing this annuity for father and mother, not figuring the income tax which was paid on the father's income (which he would have received from the farm anyway) is about $378, made up of: corporation S.S. tax $81.00, employee S.S. tax $81.00, and costs and fees in establishing the corporation $216.

"Therefore, you will see that the father's pension alone will repay all of the expenses in less than five months after he starts to take it. It is interesting to note that the cost of a comparable life annuity for the father with no benefits for mother is $13,897.00 through a private insurance company.

"Of course, this situation only works when a person is near or over 65 and has not worked under covered employment. In this instance, other reasons besides the social security benefits indicated incorporation. . . ."

[12] Case provided by R. S. Smith, Associate Professor, Cornell University, Ithaca, N.Y.

Government Experience with Corporate Farms

In the trying days of the depression, an attempt was made by the Farm Security Administration to give small farmers the believed advantages of incorporation. A few communal farms were established where facilities were to be owned by a group of families and net earnings, if there were any, were to be distributed according to hours worked. Also, many government sponsored cooperatives were organized. The tradition of independent farming was so ingrained among low income families that participants in these programs were hard to secure One manager commented to a visiting committee: "I'm only sticking with this setup long enough to get me money to get a place back in the hills." The experiments were not a success during their short life. Congress brought them to a rapid end in the early 40s because of the conflict between family farm and communal ideologies.

Summary

The corporate structure applied to farms offers certain advantages. It appears to do more toward assuring security to the farm operator and his family than to the increasing of their farm income. For older farm operators social security benefits may soon exceed costs of incorporation.

The farm corporation as a threat to the family farm, which is prized so highly in our society, is unfounded. The family farm may actually be perpetuated through the corporate device. The association of corporate farms with large scale farming is not necessarily valid. Empirical research does not establish the generalization that large scale farms are more efficient in production than family farms. Particularly important are the conditions which govern certain types of agricultural production. Certain factors of production are more divisible than others and varying proportions in productive combinations may lead to increasing returns and decreasing unit costs. Or the converse may be true. On many family farms the labor and management factors, fixed in quantity, may be combined with increased amounts of capital to expand production at decreasing unit costs.

Considerable more research into the several aspects of corporate farming is needed. Because of the few farms now incorporated and their great variability, the case method can best be used. For carefully selected models with given conditions as to age of operator, capital structure, other size criteria, etc., the benefits of incorporation can be balanced against the additional costs.

CURRENT RESEARCH IN LAND ECONOMICS

Chairman: G. T. Blanch, Utah State Agricultural College

RESEARCH INTO OBSTACLES TO RECOMMENDED LAND USE PRACTICES

JOHN C. FREY
Pennsylvania State College

RESEARCH methodology is a very old and controversial topic, but one that always seems to be popular among research workers. Most of us already have a high degree of skill in applying the methods and techniques of research, but we still keep on the lookout for novel ideas and new procedures that might be more successful. Evidently our accomplishments never quite catch up with our ideals.

The purpose of this paper is to point out that which is new or different in research studies dealing with obstacles to recommended land use practices. Most of the discussion pertains to current research on obstacles to soil erosion control in Iowa. Not all of the methods and techniques employed in the Iowa study are new, but certain methodological aspects of the work are sufficiently different to warrant special consideration.

A Distinguishing Feature

One of the distinguishing features of the obstacle study in Iowa is its explicit conceptual framework of analysis. The study is designed along normative lines. First, an "ideal" system of soil erosion control is established for the geographic area under investigation. It follows the accepted rules and standards for reducing soil losses and serves as a standard for comparison. Next, empirical observations are made to determine the "existing" system of soil erosion control in the same area. It reveals the erosion control practices that farmers actually are using. When the two systems are compared it is found that they do not correspond. Consequently, attention is directed toward measures for removing some of the disparity between them. This is done in part by delimiting obstacles in the situation and by proposing methods for overcoming them. It is also accomplished in part by modifying the original system of erosion control accepted as the "ideal"

There are several reasons why a design of this type is desirable in research. It orders and brings together a whole cluster of related problems that need to be solved if an existing issue is to be settled. It provides an over-all picture of the problem situation and helps the research worker

classify and discriminate subject matter when he plans his program of research. And finally, the design aids in bringing about interdisciplinary cooperation. It uncovers problems that transgress boundaries of academic specialization, and provides a basis for exchange of knowledge in trying to arrive at their solution. If all knowledge is related, then we need research studies that are not limited entirely to specialized subject matter areas.

Other distinguishing features of the Iowa study are procedural in nature. Therefore, the remainder of this paper is devoted to a detailed description of techniques used in each phase of the work, with brief mention of some of the results obtained.

The Ideal System of Erosion Control

A soil loss of not more than 5 tons per acre per year was conditionally selected as the goal of soil erosion control in the Iowa study. Technicians believed that this rate of loss was permissible for the Ida-Minona soil area under consideration. To attain this goal, certain erosion control practices had to be followed. Terracing, contour planting and cultivation, high-forage rotations, contour-listing, fertilizers, and grass waterways generally were essential. The relative effectiveness of each of these practices in reducing soil losses had previously been determined by agronomic investigations. Moreover, rules and standards had been set up for determining the exact combination of practices needed to obtain a given rate of soil loss on any tract of land. Thus, it was possible to design an erosion control plan for any farm in the area, showing what practices were necessary to attain a soil loss of five tons per acre and how these practices should be carried out.

Ideal erosion control plans of this type were designed for 144 sample farms. Not only did they serve as benchmarks when obstacles were being discussed with the farm operators, but they also provided essential data for estimating the erosion control needs of the entire farming area. On the average, at least six practices were needed per farm if soil losses were to be reduced to the 5 ton maximum. Hay and pasture crops were needed on 43 percent of the land area studied. It was permissible to use row-crops on only 22 percent of the land.

The "ideal" system of erosion control, as established in this study, has one serious limitation. It is based almost entirely on physical measures and the recommendations of action agencies. There is no assurance that it will bring about desirable economic consequences. It seems logical to start with physical concepts in an investigation of this kind, but eventually their economic feasibility needs to be determined. Whether or not continuing phases of the study will actually do this still remains to be seen.

The Existing System of Erosion Control

The farm operators in the sample were interviewed to determine the "existing" system of soil erosion control. All of the erosion control practices being used on their farms were recorded on aerial photographs during these interviews. Later in the analysis, an "existing" rate of soil erosion was determined for each farm by substituting values for the practices being used into a formula for estimating annual rates of soil loss. Generally, only one or two erosion control practices were being used per farm, and the average rate of soil loss was found to be 20.8 tons per acre. Rates of loss as high as 60 tons were found in some instances. Thirty-seven percent of the farm land was actually being used for row crop production at the time of the survey.

Lack of Correspondence

It was quite apparent that the "existing" system of erosion control did not correspond with the "ideal" one. A 16 ton per acre reduction in soil losses was necessary to bring about the desired amount of erosion control. On the average, farmers were not using four or five of the practices necessary for their farms, and shifts from corn to hay and pasture production were needed on at least 15 percent of the land.

The farms sampled in 1949 were checked again in 1953 to see if any progress had been made in reducing soil losses. Results indicated that actual rates of loss had been reduced 1.5 tons per acre over the three year period, but this change was not statistically significant. Several of the practices showed a gain in use over 1949, but in general the recheck indicated that improvement was not very great.

There was some question as to the representativeness of the sample when this recheck was made in 1953. Approximately 25 percent of the operators had changed, and there were indications that those who remained had been influenced in their attitudes and actions by the preceding interview. The amount of error in a continuing line of research of this type is very difficult to determine.

Delimiting Obstacles

The obstacles to soil erosion control were delimited largely on the basis of farmer opinion. Fifteen obstacles were hypothesized at the beginning of the study, and these were subjected to testing during the field interviews. To make the test, operators in the sample were shown the ideal erosion control plans for their farms and were then asked to indicate whether or not each of the 15 obstacles under consideration had kept them from following the methods and procedures prescribed in the plans. Soil losses on farms of the operators who confirmed each obstacle were

then compared with soil losses on farms of the operators who answered in the negative to see if significant differences existed.

Each of the hypothetical obstacles was confirmed by some of the operators in the study. But significantly greater rates of soil loss were found on the farms of those operators who indicated that one or more of the following had retarded their accomplishments: (1) The change required in livestock enterprises, (2) The rental arrangement and landlord's cooperation, (3) High debt position and high operating costs, and (4) A short expectancy of tenure.

There are several limitations that might be mentioned in this phase of the study. One is that the obstacles are classified into such general categories that recommendations for overcoming them cannot be made until they are described in greater detail. Furthermore, some of the most important obstacles may not have been included in the 15 hypotheses tested. Other areas of difficulty still need to be investigated before too much emphasis is placed on remedial measures.

The main obstacles to soil erosion control are only reasonably well-founded in the study. More evidence is needed to conclusively show what actually keeps farmers from taking action. Farmer opinions are helpful in approximating the general area of difficulty, but they are hardly sufficient to objectively nail down all of the economic limitations. Farmer opinions are also subject to change from day to day, so that the results of the study may not hold for a very long period of time. Nevertheless, this phase of the investigation does open up avenues for future research, and is an important first step in trying to resolve a very popular issue.

Modifying the Goal of Soil Erosion Control

It was recognized that all the disparity between the "existing" system of erosion control and the "ideal" one was not necessarily due to obstacles. Farmers may not have been in agreement with the goal selected for the study. For this reason, an attempt was made to find out how much erosion control farmers actually thought was needed. This farmer goal was determined by asking all of the operators in the sample what practices they believed were needed on their farms, and then calculating what the rate of soil loss would be if these practices were followed. In general, farmers did desire more erosion control than was being accomplished at the time of the survey, but not enough to bring soil losses down to 5 tons per acre. Their goal, as established in the study, was approximately 15 tons per acre. Reasons why they were willing to accept a higher loss were not determined. But results obtained in this phase of the study did point out the need for more research on the profitability of different levels of soil erosion control. The goal of technicians working on erosion control pro-

grams either needs to be economically substantiated or else modified.

Recent Developments

Recent developments of this program of research are directed toward further refinement of the obstacles and a more thorough analysis of methods for overcoming them. In early phases of the work, operators who were following the accepted practices suggested remedial measures that others might use. Some of their suggestions appeared to have merit and will be subjected to further investigation. Others were quite unique and appeared to have very limited application. Generally speaking, case studies are now being made to find out what factors are responsible for successful accomplishments.

One study now in progress concentrates on the tenure obstacle. Farms of tenant operators who have indicated that their rental arrangement is an obstacle are being compared with farms of owner-operators who are following most of the recommendations. The objectives of the study are to find out what factors associated with tenure are retarding erosion control accomplishments and why owner-operators are more successful. It is too early to comment on the success of this phase of the work, or to mention any of the results obtained.

Summary

In summary, the normative framework that guides this program of research into obstacles is probably its outstanding feature. Much of the work done thus far has not quite come under the realm of rigorous economic analysis. Perhaps it has not had sufficient time to completely satisfy this obligation. There is, however, a definite need for an objective economic appraisal of the goal of soil erosion control and a more objective analysis of some of the economic retardations. In a purely economic sense, this research study is not drawing to a close—it is just beginning.

RESEARCH INTO EQUITY CONSIDERATIONS IN TENURE AND CREDIT

BALDUR H. KRISTJANSON
North Dakota Agricultural College

WHETHER land economists choose to deal explicitly with considerations of equity or not, they are basic to many of our day-to-day problems. I need not remind you that landlords and tenants alike, never tire of asking the "college" whether a particular lease is fair or how to share the costs of some practice recently adopted. In the field of credit we are still in the midst of an upsurge of interest in problems of beginning farmers as they attempt to meet high capital requirements. This interest derives, at least in part, from a fear that a fair allocation of farming opportunities is becoming difficult to maintain. Directly related to this, although a special case, is the question of how the influx of G.I. trainees is to be served in the matter of gaining access to adequate land resources. If one attempts to deal with these problems seriously, the inadequacy of existing reference materials becomes a matter of some concern.

The point of departure for this essay, however, is not an appraisal of the quality of data obtained in our research programs but rather, the reasons for and the consequences of the absence of certain types of data. It will be argued that we beg particular issues rather consistently for a variety of reasons, and that this gap in our information can be filled in part at least by the adoption of a broader point of view by research workers. By a "point of view" I mean the responsibility which the investigator feels or recognizes as his in serving the research needs of his society. My remarks have as their focus the research activity in agricultural tenure and credit.

Efficiency Analyses Predominate

Tenure arrangements and credit policies serve as institutional vehicles by which job opportunities are rationed in agriculture. They determine in large measure also the dispensation of rewards to labor expended and capital invested. But seldom does our research lead to any serious analysis of these institutions as rationing instruments from this point of view. We seems to take for granted that tenure and credit policies function satisfactorily in purveying both the rights to a job in agriculture and the factor rewards. Yet the rules of the game which establish tenure rights and credit policies can hardly be taken as inviolate. To do so is to assume that the twin goals of equity and efficiency are being adequately served.

It is not necessary here to berate the neglect of this (or any other) phase

of research programs. Nevertheless, it is well to bear in mind that the primary result of past investigations has been an amassing of data on the incidence of selected characteristics and trends. Less has been done to interpret these data with a view to examining our performance in achieving an equitable rationing of economic opportunity and rewards in this primary industry. Research emphasis has centered on getting the facts. These facts have been used for descriptive purposes and analysis of efficiency of production.

Now, these are worthy goals and much work remains to be done towards refining such data. And there are good reasons for this emphasis in preference to equity considerations. First, it is easy to demonstrate the need for more so-called facts. Second, by and large, efforts directed to this end are unobtrusive and produce a product which enjoys a wide popularity. These data have a tendency to appear neutral, although they are, of course, merely on dead center. Third, efficiency analyses, if competently carried out, are by their nature productive and therefore good from a materialist point of view. Materialism thrives on efficiency. Finally, efficiency analyses carry an aura of precision and authenticity. As a result, these are the "bread and butter" lines of most vendors of economic research.

Equity consideration have, at best, been relegated to second place. Seldom have we seriously directed our research in the farm credit field, for example, to appraising alternatives to existing lending practices as they ration opportunities and rewards. Thus colleges, at a time when thousands of G.I. on-the-farm trainees were pathetically undercapitalized, were not renowned for contesting statements of commercial lending agencies such as "the farm credit situation is well in hand. We have ample funds to take care of the demand for loans." In fact, we agreed with them, for our concern has been more one of safeguarding the investor than broadening the opportunities of borrowers. In the tenure field we have seen the egalitarianism of our land acts give way rapidly to a market allocation of land resources. Now our tenure investigations are typically centered on counteracting adverse effects of landlord-tenant contracts on conservation and efficiency of production. One could take the position, of course, that in landlord-tenant investigations, major attention has been given to equity considerations. To support this, reference could be made to many experiment station bulletins in which attempts are made to determine a fair distribution of costs and returns to landlord and tenant. It must be said, however, that most of this work has turned on determining statistically the rules-of-thumb which experience has demonstrated as reasonably stable. The broad framework of bargaining procedures has been largely ignored.

The Broader Point of View

Even those who insist that the primary purpose of economic science is to pursue the goal of efficiency through competition, must take into consideration the conditions under which individuals bargain. Hjalmar Schacht once said (with reference to international finance) that when one or two nations win all the marbles the rest must devise another game. And although the possibilities of a complete demoralization of economic life are admittedly remote in this country, we do have the problem of maintaining a competitive and creative behavior among individuals and groups. For life is fructified by competition, and competition in a capitalistic economy such as ours can survive only if positive efforts are made to equalize bargaining power.

If this be true, then a primary consideration in outlining research programs ought to be the bargaining strength of the contenders in relation to what we consider a reasonable outcome of the contest. And this outcome should be appraised in terms of its contribution to the total range of values we seek to attain individually and as groups. Efficiency studies alone are insufficient.

Up to this point most of us are probably in agreement. But the practical question is one of how one relates in actual practice his research efforts to such a broad goal. Would we not become "bogged down" in policy issues to the point where the shorter-run needs could not be met?

This is a calculated risk. The alternative to bogging down is not the begging of issues. As pointed out earlier, there are wide areas in which useful research can be effectively executed without constantly reexamining its relationship to the broader social goals. This holds in an economy where we can take as a point of view that our institutions are serving reasonably well and that the majority prefers to maintain a good measure of stability. But the validity of *particular aspects* of this position should always be open to question. For the degree to which the status quo is accepted is in itself a matter of judgment. The crucial issue is one of odds as to what changes are likely to be considered desirable by the majority within the period relevant to the problem under investigation.

The preoccupation with efficiency studies in preference to the broader and more controversial issues of equity is not likely to undergo any radical transformation. This holds true even if, here and there, a candid examination of the net effect of research being done produces temporary discomfort. I am reminded of a seminar led by a Corn Belt administrator of agricultural economic research. He confessed that for 30 years the focus of the entire staff of his department had been one of demonstrating the greater efficiencies resulting from major shifts in farm organization and larger scale of operations. The fact that many well qualified farmers were

unable (due, among other things, to tenure and credit restrictions) to implement the suggestions had been neglected. And this neglect can be overcome only through a basic reorientation of research programs not easily achieved. The basic problem, of course, is that any change in institutional arrangements must meet the test of equity considerations. These, in turn, involve so-called "policy issues" which may insist defy scientific analysis.

Expanding the Scope of Landlord-Tenant Investigations

Let us take the farm rental market as a case in which most investigations, on the surface at least, involve questions of equity and, eventually, broader policy issues. It is of interest here, due to the prominence given in the past to: (1) an equitable division of costs and returns, (2) reasonable compensation for unexhausted improvements, and (3) security of tenure for the tenant. Note the prominence given to matters of "fair play" in landlord-tenant investigations in view of the fact that we find no counterpart in other fields such as farm management and marketing. Could it be that renters, in a large number of cases, have the bargaining strength necessary to contest rather effectively the power of the landowners? If so, the requests for arbitration are readily explained. And is it not possible also that the institution of tenancy is peculiarly vulnerable on ethical grounds in a country ostensibly committed to the family farm ideal? If the answers to these questions are in the affirmative (as I believe them to be), our research involvement develops logically. But the particulars of research procedures from which recommendations can be made are far from obvious. Let us now turn to this phase of the problem.

In general, we appear to agree that the returns from a rented farm ought to be shared in proportion to the contributions made by each party. The goal is therefore conceptually clear. However, it involves us immediately in questions of measurement which are not readily resolved—so much so, in fact, that the "contributions approach" has been all but abandoned. Where the contributions by each party are quantitatively and physically similar, its utility is high. Its value as a standard diminishes progressively, however, as contributions vary and the need for placing values on them increases. Thus, for a labor contract, the contributions approach serves no functinon, but its value is unquestioned where the contributions are identical or at least quite similar.

Having recognized the shortcomings of the contributions approach, we fall back on determining what is "customary." In other words, the goal of equity is assumed to evolve from experience. This is a faulty assumption quite apart from the practical problem of matching cases. For this is tantamount to assuming that the farm rental market, through trial and error, (some call it competition), resolves the contest fairly. It assumes the

problem away in spite of ample evidence that inequities may also be customary.

The logical alternative to this impasse ought to evolve from a reevaluation of the basic propositions which produced it. The first of these—equal effort, equal reward—is ethically tenable but operationally difficult to apply. The second, reliance on custom, falls short since it obscures differences in bargaining strength of landlord and tenant. And this is a critical weakness, for if we have to abandon the first proposition we are left with the necessity of expediting reasonable bargaining procedures.

We have a long way to go in devising means for doing the type of research in landlord-tenant relations which serves this end. A partial list of problems serves to illustrate this point:

(1) How is bargaining strength to be measured? It depends upon factors ranging from any number of subtleties in human relations to the number of tenants available in relation to the available supply of land for rent. In a recent study we attempted to determine whether, in a given area, there was a supply of tenants in excess of the land available. Almost invariably the landlords replied in the negative. First, they pointed out that the term "tenant" has to be qualified by such terms as "industrious," "honest," "with a good line of machinery," etc. Second, they insisted that good tenants would always be scarce. They apparently assumed a normal distribution. Having gained little from this line of attack, we attempted to study particular aspects of bargaining. We asked such qeustions as: (1) When discussing the rental to be paid, did you jointly consider alternatives to the rent agreed upon? and (2) Was any consideration given to differences in productivity of the soil? Similar questions were asked about notice of lease termination, compensation for unexhausted improvements, cash rent for buildings, long-term leases, etc. The result—we had to conclude that in North Dakota little overt bargaining occurs in the majority of cases. Custom rules the day. It was primarily on matters which custom provided no answers that higgling occurred.

(2) The cost aspects of interviewing and drawing a sample from which to generalize are a major factor. There is the matter of locating both the renter and the landlord involved. Where absentee ownership is common this is virtually impossible. Cross-checking is therefore not feasible. Yet it is important to obtain personal interviews, since the details of rental arrangements are often subtle and of an endless variety.

(3) Family arrangements often account for a high proportion of rental contracts in a given area. What are the intangible values and disutilities in such cases and how can they be ferreted out?

Have we now exploded the alternative to the impasse referred to above? Not at all. We merely retreat to another plane of investigation. From this point we observe two facts: First, where landlord-tenant fric-

tions arise, the cause is most frequently found to be a farm unit so under-capitalized or so poorly organized and managed that no variation in sharing costs and returns would result in satisfaction to both parties. Second, satisfaction to both parties is likely to result only from the application of creative bargaining.[1] By this I mean that the basic problem of farm size and organization is correctly diagnosed, that landlord and renter freely express their views as to what each considers a reasonable outcome and that both earnestly try to visualize and to meet the vision of the farm unit necessary to achieve the desired results.

From this it follows that landlord-tenant investigations could be broadened to include a search for examples of successful creative bargaining. Such examples could then serve as a reference point for dealing with problem cases as they arise. If the necessary mutual goodwill and trust are not present in any given case, the contract should probably be terminated as soon as convenient. If, on the other hand, the limiting factor is a lack of access to adequate credit or land resources, the two parties would probably have to accept customary terms as the best attainable for the time being.

The creative bargaining approach achieves one thing at least—it throws the controversy into the bargaining arena explicitly; it unties custom where possible; it paves the way for a thorough discussion of each aspect of the lease. This, of course, is the goal itself, since no one can determine what is fair in any dogmatic fashion. The best that can be expected is that equity results from the method of approach.

In a sense, this is an effort to create a climate of public opinion and a responsiveness to it which leads to a systematic effort to achieve equity. We will reach this through research only if we assume the responsibility for bringing it about. Creative bargaining on any broad scale is not likely to develop without positive efforts based on research. The alternative is to assume that trial and error, unguided, is sufficient.

The adoption of reasonable bargaining procedures is but a part of the problem. For either the landlord or tenant may enjoy such a margin of bargaining strength that he dictates the terms of the rental contract. As an example of unequal bargaining strength I would cite you the case of two good Lutherans in North Dakota. The landlord gave the tenant the choice between (1) joining the landlord's branch of the church and paying his one-third of the crop or (2) remaining true to his religious preferences and paying the landlord two-fifths of the crop. The tenant had found a market for his soul, the price being 7% of his crop!

It is not an easy matter to counterbalance such power. But two possibilities come to mind. A public land purchase program could be de-

[1] B. H. Kristjanson and Ernest Solberg, "Farm Rental Bargaining in North Dakota," N. D. Exp. Sta. Bul. 372.

veloped through which land would be leased according to rules embodying the objectives of both the tenant and the public. I am more aware of the hue and cry against such a proposal than any systematic analyses of its possibilities. More promising at the moment, however, is an expansion of the tenant-purchase program of the Farmers Home Administration. This experiment deserves broader consideration in our research than it has heretofore received. Let us examine that program briefly from the point of view of the governing proposition of this paper.

The F.H.A. Approach to Credit Problems

The tenant-purchase program was an attempt to meet not only the tenancy problem but a considerable range of credit stringencies in agriculture as well. Ideologically, the "tenancy problem" was a concern over the decrease in owner-operatorship of family farms. Practically it was more a matter of raising living levels and increasing the security of expectations for tenant families. Credit, liberally applied under supervision, was to effect a rehabilitation of rural areas.

One could assume that the emergency has been met and that the existing framework of bargaining in matters of tenure and credit is satisfactory. But the success of the depression-born tenant-purchase program should, by this time, have aroused our curiosity as to its long-run implications. No longer can it be shrugged off as an idealistic experiment any more than the principle of administrative rationing upon which it stands. This is not the place to analyze the farm credit market in detail. Suffice it to say that, under present conditions, the individual's farming career is dependent to an increasing degree upon his ability to compete in the capital market. The bases for rationing, implicit in credit policies, continue to be important. Whether this is peculiar to agriculture alone or not is beside the point at the moment. What we need to remember is that farm ownership transfers are usually associated with the employment of individual families. And these are so often contingent upon the availability of credit, as is the attainment of an efficient farm unit.

Credit agencies ration funds by determining: (1) the proportion of their funds to be allocated to the various types of loans, and (2) the types and amounts of collateral security acceptable to them. The Farmers Home Administration, however, is unique in its substitution of supervision and a balanced credit approach for the high collateral requirements of other lending agencies, public and private.

This difference is a strategic one for it makes many types of credit available to strata in our society hitherto barred from the credit market. It substitutes for a blind faith in market rationing a belief in a more purposeful and systematic administrative allocation of resources.

In a recent study of the program in Eddy county, North Dakota, the

needs for it and its possibilities were abundantly clear, notwithstanding the favorable price and weather conditions of recent years. As to the need, we might point to the excessive requests for loans in relation to the funds available. Another way of expressing the need is to cite one of a large number of examples from our Eddy county study. One couple started out in married life by doing janitor work, dry cleaning, construction work and day labor. Next, they hired out as farm hands for a period of 12 years, acquiring sufficient capital to rent a farm. The landlord and tenant both lived on this half section. Presently the joint livestock herd required more acreage, so the tenant had to find another farm. He rented 320 acres, 3 small shacks comprising the farmstead. After three years, the livestock herd had outgrown this farm, so he rented a 380-acre unit. Presently this farm was sold, and he found a 640-acre unit for rent. This farm had two small one-room shacks. The F.H.A. loaned him the full amount necessary to buy this farm. The orginal home is now the quarters for a sow and her litter, but it was necessary, of course, to repair and insulate it first! With the 100% loan, it took only five years to repay the full amount.

I shall not burden you with further examples. They are many. Let us assume that this is a reasonable demonstration of the need for the F.H.A. program. But what of our research needs?

There are many facets to this experiment that deserve attention. Again we shall list but a few: (1) What is the marginal productivity of F.H.A. loans (by type of loan) in relation to alternative outlets for public investments? (2) If the productivity is lower in monetary terms, what is the value of intangible benefits? For those of us who have interviewed Farm Ownership borrowers would find it difficult to write off completely the humanitarianism of the program. (3) What are the possibilities of integrating F.H.A. lending with national fiscal policy? (4) The effect of F.H.A. credit on the land market may be great or small. Its potential effect needs study. (5) The insurance principle is now being applied to F.H.A. loans. This development may point the way to a much broader application. (6) Is there not ample justification for placing F.H.A. loan funds on a revolving basis rather than keeping them subject to the vagaries of appropriations? And (7) the entire supervisory phase presents a field ripe for exploration. The qualifications for county supervisors, optimum case loads, the number of visits by the supervisors, and possibilities of varying the amount of supervision in accordance with selected factors have had little attention from our profession.

The easy way out is to assume that administrative rationing is less effective in the long run than the unhampered market. In fact, it is fashionable to assume that the 100% loan cannot be repaid, for by theore-

tical definition this is a truism. The unfortunate part of this definition, as of so many others, is that it has little relevance to the universe to which it is conventionally applied.[2]

Conclusions

Having surveyed briefly one aspect of the research needs in tenure and credit and offered some suggestions which may help in meeting them, one further question should be raised. Bluntly stated, it is as follows: How can one prove that more emphasis should be placed on equity considerations? Stated in another way, Why the enthusiasm for creative bargaining in landlord-tenant relations and an administrative rationing of credit such as that effected through the Farmers Home Administration?

The answer is that these are concrete proposals which place us in a better position to deal with the omnipresent struggle for a redistribution of the fruits of man's labors. Whether the contest takes the form of a regularized strike of a union in America or an open rebellion against antiquated tenure systems in other parts of the world, the basic issue is the same. It is the struggle of one group against another—the one seeking to gain, the other to maintain. The rules may differ but the game is the same. Vulgar as this may be, this is one basic fact of economic life. But is it not true likewise that the world has taken giant strides in the direction of orderly bargaining? And what better way is there to support the broader program than to serve its interests in our own back yard?

We prefer to believe that democratic capitalism, through fair competition, serves our interests and in the longer run those of the world best. But competition does not long remain effective unless positive steps are taken to maintain it through equalizing bargaining power.

Whether democratic capitalism such as ours survives depends upon its ability to maintain a responsiveness to demands for a more equitable distribution of income. Those in whose hands wealth is concentrated will always champion the existing rules of the game. But on the basis of past experience it seems reasonable to conclude that the rules will be further modified in favor of the many rather than the few.

This may appear to be an unnecessarily elaborate frame of reference for establishing the need for a broader point of view in our research. But our preoccupation with efficiency of production is not easily countered.

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[2] For an analysis of the reasons why 100% loans have been successful, see "The F.H.A. Approach to Farm Credit Problems" by Baldur H. Kristjanson and Jacob A. Brown, N. D. Agr. Exp. Sta. Bul. 386.

FARM EMPLOYMENT ESTIMATES

Chairman: Curtis Mumford, Oregon State College

REPORT OF THE AMERICAN FARM ECONOMIC ASSOCIATION COMMITTEE ON FARM EMPLOYMENT ESTIMATES

VARDEN FULLER, ROY GILLETT, EARL HEADY,
PAUL HOMEYER, D. GALE JOHNSON, *Chairman*

THE task of the Committee was to study the presently available estimates of farm employment and to make suggestions for their improvement. The major reason for the appointment of the Committee was that confusion has arisen because of the differences in the two current series of estimates provided by the Bureau of Agricultural Economics and the Bureau of the Census. The major obvious differences are in the annual average estimates and in the seasonal variation displayed. For example, in 1951 the Bureau of Agricultural Economics average estimate was 10,022,000 and the Bureau of Census (Monthly Report of the Labor Force) estimate was 7,054,000. In the case of the BAE estimates, the difference between the maximum and minimum monthly estimated employment in 1952 was 6.8 million, while for the Census, the difference was 2.0 million. The months of maximum and minimum employment also differed.

In addition to the current estimates of farm employment, the Census of Agriculture and the Census of Population provide decennial estimates. These two estimates also differ, by about two million for the two census periods for which both are available.

During the time that the Committee was conducting its study and preparing its report, the Bureau of Agricultural Economics completed an extensive revision of its estimates of farm employment. The revision accepted the 1950 Census of Agriculture as a bench mark, and on the basis of extensive analysis of available farm employment data, estimates were revised for the period from 1910 to date. The revision, which is now in press, resulted in lowering recent annual estimates of employment by about a million, but all estimates prior to 1938 were increased with the increases for early years being quite substantial. Though the differences between the revised estimates and those provided by the Bureau of Census are smaller than for the currently published estimates, the difference for 1941 is 1,569,000 and for 1951 is 1,931,000.

The BAE revision did not result from any change in methods of collecting data or in the concept of farm employment used. The major reason for the revision was the availability of the 1950 Census of Agriculture data which indicated a much lower level of farm employment than the

currently published estimates. Because the Committee believes that the BAE estimates of farm employment should be based upon a concept of farm employment other than that used in the current or revised series, the Committee has not attempted an appraisal of the revised series. The Committee wishes to express its appreciation to the BAE for making the revised series available before publication and for their courtesy in asking for our comments and criticisms.

The Committee had at all times the complete cooperation of members of the Bureau of the Census and the Bureau of Agricultural Economics. The critical comments in this report are in no sense a reflection upon the competence or professional integrity of the individuals responsible for the farm employment estimates. Most, if not all, of the suggestions made have been under consideration by workers in the agencies involved.

Any series of farm employment estimates involves decisions on three important matters:

1. The concept or concepts of employment to be used.
2. The source of the data—the employer or the employee.
3. The methods of collecting the data, including but not restricted to problems of sampling and the choice between direct interview or mailed questionnaires.

This Committee has made suggestions on each of these points. Before presenting our suggestions, however, we wish to discuss briefly the present farm employment estimates, emphasizing some of the reasons for the differences between them, and indicating some of the uses and misuses of the estimates.

Comparison of the Available Estimates of Farm Employment

While it is impossible to explain fully why the BAE and Bureau of the Census monthly estimates may differ by two to five millions and the Census of Agriculture and the Census of Population estimates by two millions, the dissimilar definitions of employment undoubtedly contribute substantially.

First, the definition of a farm that underlies the different estimates is approximately the same, though it is not entirely evident how the Census defines a farm in the Monthly Report on the Labor Force and the Census of Population. Second, there are differences in what is defined as farm work. The MRLF and the Census of Population exclude all work done by children under 14 and include certain clerical and secretarial jobs when performed for some kinds of agricultural enterprises and all of the employment of certain processing firms. The MRLF and Census of Population also count as employed those farm operators and farm wage workers

who were absent from their jobs during the survey week for some reason that implied a temporary absence and a reasonably early return to the job. The BAE and the 1950 Census of Agriculture have no minimum age limit. Farm operators and hired workers are required to have only a very low minimum of farm work done to be counted as employed. Unpaid family members must work a minimum of 15 hours before they are counted. In each of the estimates an attempt is made to differentiate between housework and farm work.

Third, the unit in which farm work is measured also differs between the MRLF and the BAE. In the MRLF a worker is counted in agriculture only if he meets the minimum time requirements and if his major work activity is in agriculture. The BAE unit is an individual who meets the minimum work requirements on a given farm. Thus a person may be counted two or three times if he is employed on two or three farms during the survey week and he will be counted in agriculture even though his major activity may be in nonagriculture.

The following tabulation provides a comparison of five sets of estimates of farm employment for the census periods of 1940 and 1950. It should be noted that the different estimates may not be entirely comparable because of differences in the date of enumeration, as well as in the differences in concept. The BAE enumeration is for the last week of a month that does not include the last day of the month, while the Census of Agriculture (and the Census of Population) in 1940 presumably obtained data for the week of March 24-30, 1940, but may have gotten data for a later period. The Census of Agriculture in 1950 did not specify any date, except last week (prior to the actual interview or the time the farmer filled out the schedule) and this period probably averaged near to the middle of April. The Census of Population in 1950 also enumerated for the previous week and may thus have averaged a week near the middle of April. The MRLF obtains data for the week containing the 8th of the month.

The estimates were as follows:

Agency and Month	1940	1950	Change (%)
	(millions)		
BAE, March	10.4	9.4	−10
BAE, April	11.8	10.6	−10
MRLF, April	8.5	7.2	−15
Census of Population,[1] March (last week)	8.2		
Census of Population, April		7.0	−15[2]

[1] The estimate of the number of farm operators, hired workers and unpaid family workers rather than the number employed in agriculture as an industry which includes approximately 200,000 so-called "nonfarm type" jobs in both 1940 and 1950.

[2] Because of differences in season of enumeration, the decrease in employment is underestimated. In the case of the Census of Agriculture, the 1950 Census used a more inclusive definition of farm work than the 1940 Census.

Census of Agriculture, March (last week)	9.7		
Census of Agriculture, April		8.5	−12[2]
BAE, New Series, March	9.9	8.0	−19
BAE, New Series, April	11.4	9.0	−21

The definition of a worker was not the same in 1940 and 1950 Censuses of Agriculture. In 1940 the respondent was asked to indicate the "number of persons 14 years old and over working the equivalent of two or more days the week of March 24-30." In 1950, no minimum age was specified, and any work on the farm by the operator or a hired worker and 15 or more hours of farm work resulted in the inclusion of a worker in the estimate. Consequently, the 1950 Census estimate of 8.5 million workers is greater than the number that would have been obtained had the 1940 definition been used. The definition used in the 1950 Census of Agriculture is the same as that currently used by the BAE. It is significant that the 1950 Census estimate is substantially below the currently published BAE estimate for April, whereas in 1940 when the Census and BAE were then using the same definition of a farm worker, the BAE estimate for March was 0.8 million below the Census of Agriculture. In the newly revised BAE series, the differences between the Census of Agriculture and the BAE estimate is due solely to differences in dates of the enumeration and of the estimate.

Uses and Misuses of Farm Employment Data

The major uses probably fall into three categories. First, manpower authorities and labor force analysts are interested in the number of persons employed in agriculture. Second, some individuals are interested in farm employment data as a basis for making income comparisons. Third, many research workers are interested in labor as an input in agriculture in order to analize changes in productivity and resource substitution.

The first of these uses is probably fairly well served by the major activity criterion. The third is probably best served by an estimate of the amount of farm work done, while the second (assuming that it is a reasonable use of the data) requires either an estimate of the full-time equivalent number of workers or perhaps the amount of work done. No one of the three uses can rely upon an estimate of the number of different individuals who do some farm work.

The Committee holds the fairly strong view that the present BAE farm employment series should not be so labelled because of the misuses sometimes made of the series. One of the most serious misuses of the series is made within the BAE itself. Each year in the *Farm Income Situation* and in the *Agricultural Outlook Charts,* a comparison is made between the income of farm and nonfarm workers. The farm workers income is derived by dividing net operator income plus total farm wages by the BAE

estimate of farm employment which is a gross overestimate of full-time employment in agriculture. While the employment series of employed industrial workers, which is also obtained from establishments, may contain some double counting of workers, an inspection of the series indicates that annual hours worked in recent years has approximated 2,000 or the equivalent of 50 forty-hour weeks. This particular estimate of earnings of farm and nonfarm workers frequently finds its way into the debate over farm legislation even though there are serious limitations to the comparisons.

Problems of Definition and Concepts in Farm Employment Estimates

Among the concepts of employment that may be considered, the following are sufficiently important to warrant discussion:

1. The number of hours, days, weeks, months or years of farm work done on all enterprises defined as farms.
2. The number of individuals whose major work activity is farm work.
3. The number of different individuals who perform any or some specified minimum amount of farm work during a given period.

Any one of these concepts requires a definition of the following characteristics:

1. A farm.
2. Farm work.
3. The unit in which farm work is to be measured.

Difficulties arise with respect to any one of these three characteristics of an employment concept and completely satisfactory solutions are not attainable. However, some solutions are undoubtedly more satisfactory than others and our responsibility would seem to be that of suggesting solutions that are most reasonable in terms of the major uses of farm employment estimates.

Definition of a farm. There are numerous alternative definitions of a farm, but we believe that acceptance of the Census of Agriculture definition is the most reasonable solution. It is true that a farm as defined by the Census of Agriculture is different from one census period to another and that the enthusiasm and objectivity of census enumeration is not the same from one census to another. Nonetheless, two important considerations lead us to accept the Census of Agriculture definition. First, the census provides a large body of important information about American agriculture and the content of this information is determined, in part, by its definition of a farm. Second, while changes in the definition of a farm from one census period to another do occur, these changes affect farm

units at the margin. In other words, the farms that tend to be excluded or included as a result of the change in definition (or the failure to apply a given definition consistently or reasonably accurately) produce a small part of total agricultural output and employ a small proportion of total agricultural resources. It is true that if the unit in which farm work is measured is the number of different persons who do some minimum amount of work on a given farm, a change in the number of small and marginal farms will affect the number of operators and probably unpaid family workers. But if the unit is hours or days worked or an individual whose major work activity is agriculture, the effect on estimates of farm employment will be minor.

Definition of farm work. Even after one defines a farm, it does not follow that all work done on the farm is farm work. Difficulties arise because of the close connection between the farm household and the farm firm, which creates problems in differentiating between housework and farm work. But this is only part of the problem. Other difficulties arise because of age factors—the age at which the productivity of a child is great enough to include and the age at which productivity of an adult becomes small enough to ignore. Still further difficulties arise because work done within the confines of a farm could be done either by the usual members of the farm labor force (the operator, members of his family or hired farm workers) or by paid "specialists" who are not considered members of the farm work force. Through time the purchase of labor services of the "specialists" has probably increased—truckers, electricians, painters, carpenters, tilers, feed grinders. At one time, these jobs or their equivalent were done by farm workers, defined in a commonsense way. Custom farm work has also increased in recent years. But these difficulties are not new. The same problem arose at the time farm butter was replaced by creamery butter, or when the tractor and the truck replaced the horse on most farms.

Many of these difficulties are overemphasized if we restrict our interest solely to farm labor and ignore the other inputs used in agriculture and fail to recognize the change in the composition of output. In other words, given an adequate system of national or individual farm accounting through time, it is possible to determine at least roughly the extent to which purchased goods or services and changes in the composition of farm products have substituted for work of the farm labor force. It should be remembered that when farms purchase goods or services that substitute for the labor employed on the farm, the labor used in producing these goods and services is revealed in the estimates of nonfarm employment.

As noted before, the MRLF and the BAE do not use the same definition

of farm work as it relates to the segregation of farm work from that of related industries which are largely concerned with preparing and processing farm products for market. We believe that the delineation made by the BAE between farm and nonfarm work is the more satisfactory. In any case, the two agencies should agree upon the same classification.

The definition of farm work should include the following elements:

1) Age
2) Differentiation between housework and farm work.
3) Objective of the work, in the sense of being devoted primarily to direct agricultural productive activity or maintenance work on the farm.

The unit for measuring farm work. Farm work may be measured in any one of the following kinds of units:

1) Time worked at farm work—hours, days, weeks.
2) The number of individuals whose major work activity is farm work.
3) The number of different individuals who do some minimum amount of farm work.

Neither of the two continuing series of farm employment estimates use the first unit. The MRLF uses the second unit, while the BAE uses a unit that in fact differs from all of those described, but presumably attempts to approximate the third. The BAE estimates fail to measure the number of different individuals doing farm work because the same individual is frequently counted more than once if he works on more than one farm during a given period. There is a BAE annual estimate of farm work done which accepts the first definition of a unit, but this series is more an estimate of labor requirements than an estimate of farm employment.

The committee believes that the first two types of units are the most useful and that the third unit is of little value except as it contributes to our understanding of the first two. In other words, if we know the amount of time worked, there is value in knowing approximately how many individuals were involved and if we know the number of individuals with their major work activity in agriculture, there is value in knowing how many other persons were engaged in agriculture as a secondary or incidental occupation.

The Source of the Data and Methods of Collection

Employment data may be collected either from the employer (firm) or the employee (household). Both methods have their disadvantages as well

as advantages, but either method can be used to make estimates of farm employment that are useful and reasonably reliable.

It must be recognized that farm employment estimates are relatively minor joint products of the survey machinery of both the BAE and the Census. Hence, it is not realistic to expect either agency to adopt special farm employment estimating procedures which lie outside their major-purpose mechanism. Recognizing that both agencies can obtain farm employment as joint products at lower cost than by separate estimating procedures, we believe both agencies should continue to obtain the data for farm employment estimates from the same general sources as at present.

However, each agency should recognize the particular peculiarities of its source of data and adopt a definition of employment that is useful and can be estimated on the basis of the type of data collected. While there are shortcomings in the farm employment estimates of the MRLF, we believe that farm employment concept used is useful and can be derived from data obtained from households. The same, however, cannot be said for the concept of farm employment adopted by the BAE.

Should the Government Provide Two Farm Employment Series?

The question posed by the heading to this section is important. It is important for at least two reasons. First, the two employment series presumably involve a greater expenditure of resources than would one and the additional resources might be more effectively used in obtaining other kinds of data relevant to an understanding of farm employment, such as wage rates, migration, or more detailed information on the characteristics of the farm labor force. Second, because of the differences in the kinds of data that can be obtained from households and establishments there will be a consistent difference in the estimates of the number of individuals employed in agriculture. Such differences create a certain degree of confusion among the users of the data.

These appear to be fairly compelling reasons for discontinuing one of the employment series. However, the Committee does not accept the apparent conclusion for the following reasons.

1. If one of the series were to be discontinued as a means of saving resources, it would probably be the BAE series. The major saving to the MRLF from dropping its agricultural series would be in publication expense and not in collection or tabulation expense. Given the sampling technique used in the MRLF, it is quite essential that it

treat farm employment separate from nonfarm employment. In other words, the separation of total employment into agricultural and nonagricultural employment permits greater accuracy in its estimate of total employment.

2. If the MRLF attempted to provide either region or division estimates of farm employment, the additional expense would be substantial. There are significant uses for divisional or regional estimates of farm employment and in fact the BAE is continually receiving requests for state estimates. Estimates on less than the national level can be obtained much more cheaply from establishments than from households. Consequently, much of the savings that would be achieved from dropping the BAE series would be illusory and the Committee strongly believes that the MRLF series should be continued.
3. While there must be a difference between the estimates of the number of persons engaged in agriculture based on the major activity criterion and the data obtained from employers, it is possible to modify the concept of farm employment used in the BAE series to eliminate most of this difficulty. The difference between the two series would largely disappear if the BAE measured the amount of time worked in terms of full-time equivalents rather than simply estimating the total number of different jobs in agriculture during the survey week.

The Committee concludes that both the MRLF and the BAE should continue to provide farm employment estimates.

Suggestions for Improving Farm Employment Estimates

The suggestions made by the Committee are based on the presumption that the BAE and the Census (MRLF) will continue to use the same sources of data (employer and household) and the same methods of interviewing (mailed questionnaire and direct interview with a household member) that each agency now uses. But we believe that each agency can improve the usefulness and the accuracy of its data, though perhaps at some increase in cost.

We believe that the most important uses of farm employment estimates can be satisfied by two types of data:

(1) A monthly estimate of persons in the labor force who are primarily engaged in agriculture, by age, sex, and employment categories.
(2) A monthly estimate of the labor used in agriculture, in such units as man-days or man-hours, by age, sex and employment categories.

Suggestions for the MRLF

On the whole, the Committee believes that the MRLF has adopted a concept of farm employment that is useful and attainable through its methods of collecting data. Our suggestions for the MRLF thus relate to changes that might increase the accuracy and usefulness of its estimates of the number of persons whose major work activity is in agriculture.

The MRLF limits the usefulness of its data by establishing its minimum age at 14. At least four times a year the MRLF might obtain data for children from 10 through 13. Published estimates for August, 1950 indicated that there were approximately 570,000 such children who worked 15 hours or more and over 400,000 in October of the same year.

The MRLF also limits the usefulness of its data by not more fully analyzing the time-work pattern of multiple workers. From the data as occasionally published, it cannot be determined whether the farm work (in time worked) done by workers who do some farm work but whose major work activity is nonagricultural is approximately counterbalanced by the nonfarm work done by multiple job holders whose major work activity is farm work. The Committee suggests that the MRLF investigate the possibility of determining the hours worked at each job held by the multiple job worker. This would require an additional question, but it might also increase the accuracy of the major activity criterion as a desirable by-product. This additional question would make it possible to estimate the total hours worked in agriculture by all persons considered to be in the labor force.

The MRLF has an extremely difficult task in obtaining an accurate estimate of unpaid family workers. It is probably true that the MRLF is doing a substantially better job on this score now than in the early forties since much of the substantial rise in the number of females employed in agriculture between, say, April, 1940 and April, 1949 probably cannot be explained on any other basis. However, if the increase in females employed is due to an improvement in enumeration, it means that the historical continuity of the series is impaired somewhat.

Because the MRLF relies upon households for its source of data, the MRLF probably underestimates farm employment of the migratory farm worker and perhaps the unrelated individual who lives with his employer. The Committee does not have any reasonable suggestions pertaining to this problem, but the Committee believes the problem is of sufficient importance to warrant special study.

The usefulness of the MRLF data would be increased if regional estimates of farm employment were available. The Committee recognizes that regional estimates would require a much larger sample of households than is currently used. The present sample probably does not include many

more than 3,000 households that report any farm workers. The sample for any one region would probably have to be nearly as large to ensure a reasonable degree of accuracy.

The Committee believes that the MRLF understimates the seasonal variation in farm employment. Some of the more important reasons for this underestimation have been commented on above: (1) exclusion of children in the estimates, (2) probable underestimation of unpaid family work by females, and (3) the difficulty of finding the households of migratory workers. In addition, it is possible that the present sampling areas are not distributed in such a way as to reflect adequately the agricultural areas with the greatest seasonal variability in farm employment. The MRLF now has only 68 sample areas which include 125 counties. Plans are now being considered to increase the number of sample areas to almost three times the present number. If this is done, it seems likely the seasonal variation in employment will be much more important than is now indicated. The Committee also believes that the MRLF now gives an inaccurate picture of the nature of the seasonal distribution of farm employment since the MRLF indicates substantially greater employment in June or July than in September or October. This probable difficulty may also be overcome by increasing the number of sampling areas.

Suggestions for the BAE

The Committee believes that the BAE should adopt a different concept of farm employment than it now uses. We believe that the BAE should measure the labor input in agriculture in terms of some time dimension such as hours, days, or weeks.

While the Committee does not wish to say that the present estimate of farm employment should not be continued as a by-product of the estimate of labor input, the Committee believes that if the series is continued it should not be labelled as an estimate of farm employment. The present estimate is approximately, though not exactly, an estimate of the total number of individuals who perform some minimum amount of farm work. It is not exactly this because some individuals who work on two or more farms during the survey week are counted more than once. This difficulty exists with all employment data obtained from employers, but it becomes particularly significant in the case of agriculture when the double counting within agriculture is added to the double counting that results from the many multiple job holders who have one job outside of agriculture.

The concept of employment suggested by the Committee, namely an estimate of the labor input, is one that can be estimated from data obtained from farm operators and would not require any change in the definition of a farm or in what constitues farm work. The concept would require a

change in the nature of the questions asked to permit the calculation of hours worked on each farm during the survey week. Such data are obtained now on an occasional basis for farm operators and hired workers.

The data on time worked would be most useful if obtained by age, sex, and employment categories. It may be difficult to get accurate data on the age of seasonally hired workers and even on the sex where gangs or crews are employed on a piece-work basis. Thus it might be necessary to limit the classification of time worked by age and sex for unpaid family workers, operators and regularly employed hired workers.

It may well be that some such time measure as a week or a day would be fully as useful as an hour in presentation of the data. It would be possible to establish reasonable criteria for a week, such as any individual who worked 48 hours or more or any combination of different individuals that worked an aggregate of 48 hours. This would avoid averaging into the total the unduly long and sometimes suspect work weeks of 85 or 90 hours that may be reported.

A major difficulty in changing the concept of employment arises because of the sample used by the BAE. The sample used requires numerous adjustments before it can be used to provide a national or regional estimate. It is not clear where the basic bench mark data could be obtained to apply to the type of data we have suggested. Such data are not available from the recent agricultural census nor from the recent population census. One possibility of obtaining the necessary bench mark data would be to utilize the 1954 Census of Agriculture for this purpose. This would require using the same questions on farm employment in the 1954 Census as in the questionnaires to the crop reporter list. A major difficulty will arise, however, because the 1954 Census of Agriculture will not be taken at the same time in the various sections of the country and an attempt will be made to obtain data following the harvest in the fall. Since the timing of the schedule taking must be planned in advance, weather conditions may result in the Census enumeration coming at the peak of the harvest in some sections of the country.

Another possibility that might be explored is to attempt to obtain an estimate of labor input for the previous year in the 1954 Census of Agriculture. While memory bias will enter, it should be no more important for labor than for wages paid, for example. The questions might be posed in terms of months or weeks of hired labor and months or weeks of full and part-time work by the operator and each unpaid member of the family. The Committee cannot predict, of course, how successful this procedure would be, but if it were successful, the labor data obtained in the 1954 Census would be very valuable for many research purposes as well as of value in providing data for the ongoing estimates of farm employment.

DISCUSSION

WALTER A. HENDRICKS
Bureau of Agricultural Economics

This paper calls attention to important problems of basic concepts, sources of data, and methods of collecting data. I do not qualify as an expert on farm-employment problems and should not try to pass judgment on what the content of a program of farm-employment statistics ought to be. The users of the data should perform that function. But my observations from the sidelines lead me to believe most such workers would agree with Dr. Johnson's views on concepts and definitions. His remarks on statistical precision, the characteristics of the Census and BAE series, and the question of whether or not both agencies should continue to operate in this field, were also very much to the point.

About all I can add is to raise the question of where this leads us. Any service agency, such as the Agricultural Estimates branch of BAE or the Census Bureau, is in the business of collecting data for people who need and want them. If the data at present do not meet requirements, what should be done about it? As statistical craftsmen, I and my fellow statisticians are certainly in favor of any movement to secure better data in any field. Speaking for the BAE series, we in Agricultural Estimates can see a number of ways in which both the subject-matter coverage and statistical precision could be improved. No qualified statistician in our organization would contend that three or four questions on our monthly General Crop Schedule can give a detailed picture of the farm-employment situation, or that nine questions on wage rates are adequate for the purposes many analysts have in mind. There is no mystery about what it takes to achieve any desired level of statistical precision. Matters of definition or subject-matter coverage, and the question of which agencies should do the work, could also be resolved. The statistical service agencies and the Office of Statistical Standards together can develop a program tailored to any reasonable set of specifications.

It is clear enough that the kind of program visualized here would require more resources than are now available. If it is ever to become anything more than an idle dream, the users of the data must convince the appropriate authorities that the need is important enough for the necessary changes to be incorporated into the national statistical program. As the official coordinating agency, the Office of Statistical Standards is very much in the picture and rightly so. But it is up to the users of the data to take the initiative in making their needs known and to present the case convincingly enough to warrant serious consideration.

Federal Government activities must of necessity be guided by the principle of the greatest good to the greatest number. In the field of agricultural statistics there is a constantly increasing volume of requests for more data, more detail, and more precision, on almost every subject imaginable. The competition is severe and only those which seem most urgent have much chance of receiving favorable action. Of course, changes involving no increased costs can be introduced with much less difficulty. But here too it is important that requests from users of the data be presented in such a way that they can be accepted as representing the majority viewpoint. It is safe to say that in a society such as ours the wishes of the majority of citizens will not be disregarded; all that is necessary is for them to become articulate.

CURRENT DEVELOPMENTS IN AGRICULTURAL ECONOMICS EXTENSION

Chairman: H. R. Stucky, Montana State College

THE CHALLENGE OF AGRICULTURAL ECONOMICS TO EXTENSION WORK

R. B. Tootell
Washington State Agricultural Extension Service

As I undertook to prepare for this session, it became increasingly clear to me that I, an Extension administrator, should be here in the capacity of a "catcher" rather than a "pitcher." After all, you folks working full time in the field are much more competent than I to discuss the topic "Current Developments in Agricultural Economics Extension." Furthermore, I don't have very many clear-cut ideas on my sub-topic "The Challenge of Agricultural Economics to Extension Work."

Would you consider me cynical or perhaps unappreciative if I said I doubted that Agricultural Economics has adequately challenged Extension *workers?* In spite of many outstanding exceptions, I believe that for Extension workers generally—the great body of County Agents and subject matter Specialists—this is precisely the case. Many have little appreciation of the importance of economic considerations in agriculture. Many more shy away from economic considerations, contending (and often rightly so) that they do not have sufficient competence to do educational work in this field. To dismiss the matter with the statement that they simply didn't take enough economics courses in college is not pursuing the question far enough. Important as economic considerations are in this day and age of commercial agriculture, why didn't a higher percentage of these Extension workers take more economics, or why didn't they learn more from what they did take? Far too often, it seems to me, economics courses in college, and in-service training in economics for Extension workers, does not make the subject come to life and have real meaning for these people.

I have a pet notion that one way to vitalize agricultural economics for Extension workers and prospective ones, is to give them some real honest-to-goodness training in farm organization and management. I am not talking about the traditional courses that deal largely in principles and with routine exercises; I am talking about giving them experience with actual farm situations which they can see and about which they can ask questions. This is one way I see to reconcile a great deal of the "splintered" informa-

tion the undergraduates get in many of their production courses. Likewise, it is a means of integrating a good deal of the "project" information in which Extension workers traditionally deal. Good Farm Management work involves synthesizing a wide variety of scientific facts and variables in the fields of physical and biological science, after carefully weighing them individually and in combination on the economic scales. This weighing process, it seems to me can be a means of motivating Extension workers to an increasing interest in agricultural economics.

In Extension Economics we are trying to help farmers adjust their thinking and their methods to an ever-changing economic world. Most state Extension Services have for some time been doing a fair amount of (but probably not enough) work in the field of Outlook and Agricultural Policy. But these are matters over which the individual farmer has little or no control. I am under the impression that most states have for many years neglected the field of farm organization and management. Yet, in this field the individual farmer has his greatest opportunity for adjustments. Obviously most farmers are making decisions right along with respect to organization and management. This is an area in which farmers need help, but one in which the typical Extension worker does very little. Is it because we are prone to think of Farm Management assistance as being the responsibility solely of the Farm Management Specialist? Don't we have a real challenge to develop all or nearly all Extension workers so they have reasonable competence in this field?

I am eager to hear what Jim Nielson will tell us about "Taking Farm Management to Farmers." Most Extension Directors are becoming more interested in this subject and are looking to the Michigan experiment with anticipation.

A phase of Agricultural Economics that long has presented a challenge to Extension is Outlook. I should like to make an observation and raise a question or two about this subject.

It has seemed to me that the trend in recent years is in the direction of more definite prediction of things to come. Until recently, it seems to me, the typical outlook statement hedged and qualified until the reader was uncertain what the author really believed. Am I correct in this observation? If so, what are some of the reasons for the change?

I am wondering if one reason for the improvement in outlook reporting may not be competition from commercial sources. This certainly has been expanding. Each issue of *Farm Journal* and *Country Gentleman,* for instance, contains a section devoted to outlook material. For the most part they contain rather definite predictions on price and cost trends, not only for agriculture generally but for a substantial number of specific enterprises. Private outlook services available on subscription basis are another

source of competition. Does this greatly improved outlook service from other sources which gets into a high percentage of the farm homes reduce the need for Extension outlook services?

What are the implications of this commercial outlook service for future state Extension work? Can we develop some really unique outlook service for farmers? If not, should we consider lessening or even discontinuing this work on state funds and allocating the funds so released to other, perhaps more useful, Extension economic activities?

Another question that has occurred to me is whether or not price analysis is properly an Extension function. Should not perhaps the economic researchers do the price analysis work, freeing Extension outlook people to devise more effective means of getting the outlook story across to farm people?

I don't pretend to know the answers to these questions. However, as an Extension administrator I should like to know the conclusions you who are working actively in the field of economics may have about them.

Since Agricultural Policy will be discussed by Mr. Carpenter, I shall say nothing about it except that I believe it is very important. That leaves one other major field in Agricultural Economics, the field of Marketing, to which I shall address the rest of my remarks.

Marketing of farm products becomes an increasingly important and an increasingly complicated service each year. Factors making for this are several in number but the more important are:

1. Increase in population and therefore in total consumers.
2. Not only a smaller percentage of our total population living on farms but a decrease in the absolute numbers living on farms. This is accompanied by greater concentration of consumers in the urban areas.
3. The greatly expanding number of food items that enter into the diet of the typical consumer and the distances from which many of these must be drawn.
4. The ever-increasing services that consumers demand and hence must pay for.

In the fall of 1950 an Extension Marketing conference was held at Chicago participated in by three Directors from each of the four regions and by representatives of the Federal Extension Service and the Research and Marketing Administration. Purpose of the conference was to explore and to define the educational job to be done in Marketing and to appraise Extension's needs in terms of number and type of personnel required for an adequate job. The report of this conference was titled "Marketing Challenges the Extension Service." I commend this report to those of you who are interested in the subject.

The Chicago group conceived of the marketing education job as falling into three broad categories or steps:

1. Work with *farmers,* stressing particularly the requirements of the market for each type of product.
2. Work with processor, wholesaler and retailer groups and particularly the latter, since they come in closest contact with consumers.
3. Consumer education.

It was the opinion of the Chicago group that the educational needs and opportunities in each of these fields is great. Furthermore, that if Extension did not meet the challenge, other agencies would. Director Bevan of New Hampshire and H. R. Varney, until recently Dean of Agriculture in West Virginia, have for several years worked diligently to arouse Land-Grant College administrators to the opportunities and the challenge in Extension marketing. The Federal Extension office has contributed substantially to this effort. Some progress has been made. A few states are doing outstanding work with processors and distributors; while certain others have outstanding work in consumer education. All of you have access to reports of such work made by the Federal Extension Service. These will keep you up to date on current developments.

Agricultural Economics *does* challenge Extension. It offers Extension workers a challenge to help farm people to "think economically" and to provide them with information they cannot individually obtain, which is necessary for reaching intelligent *decisions.* But how, for instance, do we get across the whole truth to farm people about price spreads and marketing charges? (By the way, city people need the same enlightening.) Both segments of the population have the traditional suspicion of the "middlemen" and the same trust in the segment of the market with which they are familiar. Both want simple explanations of, on the one hand, "The farmer's small share of the consumer's dollar" and on the other hand the "high cost of food." Do we in Extension always resist the temptation to fortify these popular and easy explanations?

Our challenge is great. Our vision and resourcefulness must be equally great.

DEVELOPING EDUCATIONAL WORK IN AGRICULTURAL POLICY

G. ALVIN CARPENTER
Utah State Agricultural College

TODAY the topics most generally discussed in agricultural circles have to do with public policies affecting agriculture. Farmers in every section of the country are becoming more and more concerned with governmental policies and with happenings outside the boundaries of the individual farm that greatly affect their welfare. Two world wars with accompanying wide fluctuations in prices plus an ever increasing agricultural technology and its consequences along with industrial development have all helped to hasten the appearance of many problems which seem to require action of groups or government for their solution. Questions relating to taxation, land use, price controls, international trade, reclamation, public finance, price supports, credit, production controls, and many others are classified into a general category which we call the field of agricultural policy or public policy.

Some Characteristics of Public Problems in Agriculture

Most of the problems in this field are not amenable to solution by individuals acting solely on their own behalf. They must be approached by group or government action. Such problems are usually controversial involving human relationships, value judgments and in many instances some compromise between the immediate interests of individuals and the longer time interests of specific groups and society as a whole. Generally there are no exact answers or single solutions to problems in this field. The public often has difficulty in differentiating between symptoms of the problem and the causes. Final decision in regard to what should be done on any specific problem is often a compromise of many honest differences of opinion.

Because of rapidly changing social and economic conditions the decisions that are made and the policies that get into action may require considerable over-hauling within a short time, so as to fit changing situations.

In these times when major public decisions have to be made of vital interest to agriculture as well as the general public, a real responsibility rests upon educational agencies such as the Land Grant Colleges to aid rural people to understand the facts involved. The responsibility of the Extension Services in this regard is becoming more clearly recognized. Not only do we have a responsibility to teach *how* to produce efficiently but we should also teach *why*. This seems to be a tougher job.

In much of our extension work in the past, we have been able to supply the farmer with rather definite answers. If a farmer wished to improve his pasture or crop land, we have usually been in a position to say, "If you do thus and so, you may expect such a result assuming normal weather conditions." If he asked what variety of crop to grow we could say that "this particular one has proved best in this area." In other words, the answer to many problems could be determined from the physical facts available and enough research and experimentation had gone on before so that rather definite answers could be given to the farmer.

In contrast to this, in the field of public policy most answers must be based not only upon facts but also upon value judgments and ethical considerations to which individuals may assign different values. Also, we do not have anywhere near the volume of research to draw from as we do in the field of production. Consequently, it is much more difficult to develop a satisfactory educational program in this area.

The formation of public policies, both at the state and national level, is greatly influenced by pressure groups. Each pressure group, not only those in the agricultural industry but in the rest of the economy as well, is constantly pressing its particular demands. No important segment of our economy is totally immune from the use of this type of power and it seems to be expanding further all the time for the avowed purpose of meeting power with power. This sort of pressure group action, although present to some extent in the early history of our country, did not exist in the proportions we find it today. Self-sufficing agriculture was not confronted with as many high cash costs and capital requirements as is modern, commercialized agriculture. The modern commercial farmer feels the effects of price fluctuations to a much greater extent than did his self-sufficing grandfather. This has led him to band together with other farmers operating in like fashion to try to maintain or enhance his economic position. Being unable to control satisfactorily many of these economic problems that operate outside the boundaries of the individual farm, the farmer through his pressure group calls upon government for aid and assistance of various kinds. As a result, the trend over the years has been increasing government intervention in the attempted solution of many agricultural problems. We can expect that problems of public policy will increase in number and importance in the future.

Type of Educational Program Needed

Most people recognize that an informed public opinion is essential to wise decisions on farm policy. Back in the early 1930's Joseph S. Davis said:

"The first step in dealing with the agricultural problem is to spread the true

knowledge of it. Much agitation for and against the whole policy of relief for agriculture and particular measures rests upon misunderstandings, incomplete analysis, and unfounded assumptions."[1]

To be worthy of the name, education in the field of public policy must be dissemination of uncolored facts and principles. Some selection of the materials to be presented is inevitable, but real education does not amount to the selection of the solutions to the problems that exist. It amounts to stimulating the whole body of people to think for themselves; to participate actively in discussing public policies and to select one of the alternative proposals according to their own uninfluenced and best thinking. Jefferson once said, "Give light and the people will find their way." As Extension workers, we have the responsibility of lighting the lamps, of presenting and analyzing possible alternative solutions to basic public problems and presenting, in so far as possible, the likely consequences of each alternative.

Education should be aimed at teaching people *how* to think through public questions rather than *what* to think. In a democracy, the formulation of sound coordinated public policies rests squarely on the foundation of education. The role of decision making is strictly a function of farm people but the process is essentially an educational process. As a rule, the people want facts and sometimes advice. They want the different issues or proposals brought out and analyzed. People cannot make judgments wisely unless the pro's and con's of various solutions are adequately presented for consideration and relevant facts made known to those who collectively must make the decisions. Even then, agreements may not be reached because of differences in value judgments and differences in economic position. The type of action or program that does result, however, will be more sound if adequate facts are presented and properly analyzed.

The colleges have been rather slow to move vigorously into this field of educational effort for a number of very understandable reasons. For example, issues of public policy are often highly controversial. Few lend themselves to simple positive solution and are often the bone of contention between political parties. The colleges are primarily responsible to the state in which they are located and are, of course, most directly concerned with state problems. It is only natural for publicly supported institutions to enter such a field with hesitation. They are very wise not to enter until they are well prepared with qualified personnel and sufficient funds to build a body of facts and are ready to support an educational program that will back up sincere and courageous leaders. All of this does

[1] Joseph S. Davis, "On Agricultural Policy," Food Research Institute Stanford University. Page 87.

not alter the fact that there is a very pressing need for more educational work to be done, and that the Land-Grant Colleges have definite responsibilities along this line.

Perhaps the Extension Services need some new "Seaman A. Knapps" to spearhead more effective educational work in the social sciences. Scholars who know the answers in this field must not be afraid to raise their voices. Social scientists must develop better techniques to deal with problems in the realm of social action, else they become passive onlookers upon the sequence of events and problems, the solution to which they should be making major contributions. Research effort in this field needs added emphasis to provide adequate facts to support a strong educational program. Special attention needs to be given to research on various alternative proposals for solution of the primary public problems.

Organization of Personnel

For years most state Extension Services have been conducting some educational work in public policy although the work may have been done irregularly and informally under some other name. Recently we have come to visualize public policy problems in clearer terms. Several of the states with larger staffs, such as Michigan, Iowa, Ohio, Indiana, New York, and others have stepped up their programs and have assigned two or more full time staff members to develop and conduct well defined programs in this field. Other states with smaller staffs (particularly in the West) have tried to carry some work with part time personnel or with staff members already overloaded with other assignments. The basic problem confronting most states is to secure well-trained personnel with the necessary qualifications to conduct effective work.

The type of personnel needed should have (1) a broad background of training in the social sciences with ample technical knowledge and grasp of principles, (2) maturity of judgment and experience in meeting farm people, (3) the necessary skills and abilities to lead and develop discussion and stimulate self expression, and (4) respect and tolerance for judgment and point of view of others.[2] These are stiff requirements which is one of the main reasons why work in this field moves slowly.

The major responsibility of staff assigned to head the work at the state level should be to develop and assemble fundamental background information on public policy problems and organize and present it in such a way that the objectives of the program, namely enlightened public opinion and decision, can result.

Some states prefer to have a special committee composed of represent-

[2] Educational Methods Conference on Public Policy, Chicago, Jan. 19-21, 1950.

atives from the supervisory, specialist, field staff, and other elements, to give guidance to the overall program. Others may have special committees or personnel assigned to deal with each specific problem such as price supports, public finance, etc. A few states may use a combination of both of these ideas. This is the general procedure followed in my own state. Still others may feel that the work might be done better by including it as a part of the established routine in other fields rather than making a special project of it. Whichever method is followed, it goes without saying that to be successful the program must have active support from the administrative head.

Since many of the problems in this field are national or regional in scope, there are many possibilities for cooperation between states in developing resource materials, especially on the broad national problems. Such cooperation would utilize personnel and other resources to greater advantage and be a big help to the smaller states. I firmly believe that possibilities for interstate or regional cooperation in preparing and exchanging background materials needs further investigation and development.

National and regional conferences sponsored by the Farm Foundation and the National Educational Committee on Public Policy the past year or so have assisted greatly in upgrading personnel, building background information and increasing the understanding of many important public policies and problems. This activity should be continued and expanded.

In organizing and conducting our programs, we must emphasize work through the county extension agents. They make hundreds of contacts with farm people where state workers make one. Many farmers expect the agent to give them answers on public policy questions; and whether right or wrong, the agent does deal with them. He may either contribute to increased public understanding or he may add to error, depending on his training and ability. County agents frequently say they want to steer clear of certain public policy questions primarily because of the controversial nature of the problem and because they do not feel secure and trained well enough along specific lines to handle them. This is only natural.

If we want the educational program to penetrate to the "rank and file" farmers, county agents and all, leadership connected with the program will need additional in-service training. We simply cannot and will not teach other people that which we do not understand ourselves. We must also recognize that this field is very dynamic and we must keep abreast of the issues.

Regardless of the amount of training given county workers, specialists and others, we can expect some repercussions as we work in this field,

especially if the subjects are controversial. Remarks are sometimes misunderstood and mistakes are made. As we gain experience and improve our techniques mistakes can be minimized.

Like in other phases of Extension work, the specialist cannot hope to reach all the people. His primary function is to analyze data, assist the county agent and local people in selecting the problems to work on, and prepare materials and teaching aids to do this job. In this effort he should work closely with the research personnel. In addition to direct contacts with farm groups where possible, the specialist must also train agents in both subject matter and techniques. Needless to say, he will have a full time job. The work will move slow and be less effective where personnel is assigned to this responsibility only part time or spasmodically.

Techniques and Procedures

Because of the character of the problems in this field, educational procedures must be utilized which will stimulate the most people to think and which will contribute most to basic understanding of problems. Undoubtedly most of the techniques used in other extension activities might be used but without going into details with which most people are familiar, I would say that various discussion techniques, forums, and panels should predominate. Lectures are, of course, important to get basic facts and ideas before the people, but people should also be given a chance to discuss the issues and participate where possible so that more effective learning can take place. Discussion leaflets such as "agree or disagree," "question and answer" and other types may all help to stimulate participation of people. Also, there are possibilities for utilizing more visual aids, films, radio and television programs to get people interested in the basic issues. Even tours might be developed to help emphasize the importance of certain public problems. I doubt that we have explored these possibilities enough.

As educational workers in this field our objective should be to arrange what psychologists call "learning situations" wherein the people can become motivated and actively participate the most. Under such conditions, the greatest amount of learning takes place.

In developing our procedures and conducting our programs, careful consideration must be given to basic questions such as:

1. With whom do we start, key leaders or with the masses? Do we start at the top or "where the people are"?
2. To what extent must the professional worker carry the ball or can local leaders be trained to take over?
3. What should be the relationships with general farm organizations and commodity groups in conducting the program?

4. Who should decide which problems need major attention and when?
5. Is our educational objective to give farmers information that will help them personally or to concentrate more on achieving the general welfare?
6. Is the program to be continuous or spasmodic?
7. To what extent are women workers to be included?

These are but a few of the fundamental questions that must be considered. The answer will vary between states so there is little need to discuss them in detail here.

Summary

In the foregoing discussion, I have tried to describe somewhat the characteristics of public policy problems and indicate the type of educational program needed to deal adequately with them. Economic questions are usually involved but we must remember that economic considerations are not the only ones taken into account in reaching decisions.

Government in a democracy should be concerned with the encouragement and development of individual opinions and judgments. Any educational program that aims to implement these objectives must include the opportunity for all sides to be heard and discussed. Only in this way can government discover mistakes that might be disastrous. The farmer's judgment is very important. He often sees and understands things that the "specialist" does not. The specialist often fails to see his own results in their proper perspective. What is needed is a synthesis of the best thinking of all groups concerned to evolve the best balanced program.

In conclusion, the role of extension education in public policy is not to initiate action on policy issues but to equip rural people to take intelligent action through proper channels. The educational program should be comprehensive enough to include the means of transmitting the conclusions and judgments to those who have primary responsibility for initiating action whether legislative, administrative or other.

TAKING FARM MANAGEMENT TO FARMERS

JAMES NIELSON
Michigan State College

IN THE time which is allotted to me, I would like to (1) outline what I believe to be the proper functions of a farm management extension program, (2) tell you a little about our farm management extension program in Michigan—particularly how we take farm management to farmers in group meetings, and (3) briefly evaluate those meetings in the light of the functions outlined.

The Functions of Farm Management Extension

Obviously the extension worker's concept of his objectives will influence his decisions in allocating his time and in evaluating his work. I do not intend to get into a discussion of the objectives of the Extension Service, although I believe that these are relevant to the discussion, and I think that the objectives of the Service need to be clarified and stated more explicitly than they have ever been stated to date. I will not attempt to undertake this task, however, but rather will state what I believe to be the proper functions of a farm management extension program within the rather loose, broad objectives of the Extension Service as they are presently stated.

I consider a farm management extension program to have three broad functions: (1) to teach economic and managerial principles to farmers, (2) to provide farmers with the data they need to make sound decisions, and (3) to help train the field personnel who can assist us in carrying out the first two functions.

With reference to the function of teaching economic and managerial principles, I originally started to say "to teach farmers how to plan." Teaching methods of planning is a part of the job. But what I have in mind is considerably more inclusive than teaching farm families how to work out farm, or farm and home, budgets. In the first place, in order to provide an effective basis for teaching farmers how to plan, we need to teach economic principles and to illustrate their application to problems which are meaningful and important to farmers. Perhaps more importantly, we need to teach management as such. That is, we need to teach farmers how to better perform the functions of management. As farm management extension specialists, I think we can be of help to farmers in teaching them how to better perform the first three functions of management: first, how to be better observers or how to obtain information; secondly, how to be better analyzers, or how to determine what information is relevant and how it fits into their farm and home situation; and thirdly, how to better carry out the decision-making process. In teaching

decision making, we must recognize that knowledge is imperfect and that decisions are made under conditions of uncertainty—and therefore that farmers must plan on the basis of learning and adjusting to new situations. And if we admit uncertainty and imperfect knowledge we cannot ignore the home aspects of decision making since in anything approaching a dynamic planning procedure, the firm and the household aspects of farming become inseparable. A very useful tool which is now available for teaching decision making is a recent bulletin by Johnson and Haver.[1]

Under the heading of providing farmers the data they need to make sound decisions, one of the most important jobs of farm management extension is to take to farmers the data provided by farm management research. Not all of the data needed by farmers is provided by farm management research, however. In the bulletin referred to above, Johnson and Haver have classified the data needed by farmers into five subject-matter areas as follows: (1) price structures and changes, (2) presently-known production methods and responses, (3) prospective technological developments, (4) the behavior and capacities of people associated with the farm business, and (5) the economic, political, and social situations in which a farm business operates.

With regard to the first of these categories, I believe it to be a proper function of farm management extension to take to farmers the best short-run and long-run price forecasts which agricultural economists can make (along with the reasoning behind them) for farmers to use in formulating their own subjective evaluations of future prices. With reference to the second and third categories, an important kind of data needed is on physical input-output responses, much of it in variable proportion form. It is the responsibility of research workers in technical production fields to obtain these data, and perhaps of extension workers in those same fields to take the data to farmers. But farm management workers have the responsibility of showing what data farmers need, why they need them, and how the data will be used. Farm management workers can well serve as counsellors in setting up technical production experiments, and help to analyze the data and interpret it from an economic standpoint. Sociologists and psychologists should be able to make a contribution to the fourth category concerning the behavior of people. Agricultural economists' work on farm labor relationships falls into this category. In addition, our program for teaching decision making ought to make farmers aware of the importance of appraising the human factor, including their own managerial capacity. The fifth category also is not the sole function of farm management specialists; help in this area should be provided by workers in agricultural policy, sociology, and political science.

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[1] Glenn L. Johnson and Cecil B. Haver, *Decision-Making Principles in Farm Management*, Ky. Bul. 593, 1953.

Farm management extension workers cannot do the job of teaching decision making and taking data to farmers by themselves. Time and personnel are inadequate, and more than likely will continue to be. Therefore, we need a large number of field personnel to assist us. At present, the most logical group of helpers is our county extension personnel. For various reasons, many county extension workers are not well trained in farm management and are not equipped to teach economic principles and decision making. Since this is the case, they need to be trained in these areas before they will be effective helpers. It is particularly important to provide training to those who will be participating in farm and home planning and similar programs. We should also take the opportunity to provide farm management training to potential workers outside the Extension Service if they desire this help. I think a particularly potent group to work with is the vocational agriculture teachers. Again, the task of training field personnel is not the exlusive responsibility of farm management extension.

The Farm Management Extension Program in Michigan

A few words of background may be helpful in visualizing the farm management extension program in Michigan. At Michigan State, farm management is one of four extension projects in the Department of Agricultural Economics. All extension personnel are housed and administered in the department. There is an equivalent of four full-time extension men in the farm management project. The housing of the extension workers with the rest of the department and the joint appointments makes for a close relationship between farm management research and extension which I believe is desirable.

The present status of our farm management extension program is to an important extent the outgrowth of two series of program evaluation sessions which were arranged by the project leader and participated in by all personnel in the project. The first of these was held early in 1951. The purpose of the discussions was to critically review and appraise all of the work currently being done in the project, and to take a look down the road to determine where we wanted to go in years ahead. We listed every activity which was underway in the project, and every activity which any of us could imagine would be a proper function of our farm management extension program. We gathered as much information as possible on each of these activities, analyzed each one carefully, rejected some, and perhaps most important of all—assigned relative priorities to those things which we wanted to include in our program. In the process we consulted with research workers and other members of our department, the department head, and with the extension administrative staff. From them we got a number of good ideas for improving our program, and where necessary,

approval for our proposals. This process was fairly time consuming; it required about two full weeks of the entire farm management extension staff's time. However, we believe that it was time well spent, and we took time out to reappraise our work early in 1953.

The main activities of our farm management extension project at the present time are as follows:

1. *Farm business analysis project.* Approximately 600 farm records are summarized each year and 15 farm business analysis reports published.
2. *Farm records distribution.* For a number of years we have been distributing about 20,000 farm account books each year. In 1952, we designed a new simplified farm income tax record and distributed 30,000 copies of it. We have plans for distributing 50,000 to 60,000 copies late in 1953, largely through sponsorship of members of the Michigan Bankers Association.
3. *Farm management outlook.* Part of our time is devoted to writing monthly and annual outlook statements for the department's publication, *Michigan Farm Economics.* Outlook releases are made to the *Michigan Farmer* and other publications throughout the year. A discussion of outlook is included in most of our farm management meetings during the fall and winter.
4. *Leases, father-son partnerships, and property transfer.* Work in this area consists primarily of distributing forms and publications.
5. *Farm income tax.* A member of our staff helps write the North Central Regional bulletin on farmers' income tax which we distribute in Michigan; he also prepares releases on farm income tax for the press, radio, and television.
6. *Assistance to vocational agriculture teachers.* We try to provide considerable assistance to vocational agriculture teachers by providing publications, forms and other teaching materials, by conducting a Future Farmers farm management contest, and by holding training sessions for vocational agriculture teachers.
7. *Farmers Week.* Each year during Farmers Week we present a farm management program. In 1953 the program was presented twice and approximately 1,200 attended.
8. *Farm management banquet.* A farm management banquet is held each year during Farmers Week and is attended by upwards of 500 people.
9. *Farm management tours.* During the past five years we have held an annual state farm management tour. Attendance at this year's tour was 1,400. In addition, 12 county farm management tours are also being held during the late summer and fall.
10. *Training school.* We have recently agreed to hold a series of schools to provide farm management training to field personnel. Nine of these all-day schools have been scheduled for the month of October. The following personnel will attend these schools: county agricultural agents, vocational agriculture teachers, veterans' instructors, National Farm Loan Association secretaries, and field personnel of the Soil Conservation Service, Farmers Home Administration, and Production Credit Administration. At these training schools we intend to stress the teaching of planning techniques and decision making, and to provide those participating with a handbook of farm management data.

Farm Management Meetings

For a number of years our farm management meeting schedule consisted of meetings which were held on requests from county agents or from groups which requested a speaker. The meetings covered a wide range of subjects, but leaned heavily on farm business analysis factors taken from our farm-account project. Since the requests came trickling in at various times, and often not too long ahead of time, we found it difficult to make efficient use of our time. Furthermore, we had either to agree to talk on the subject requested, in which case we were often not well prepared, or else we had to suggest that the group requesting the meeting accept a subject on which we had already made some preparation.

One of the decisions which grew out of our evaluation discussions was that we would no longer build our meeting schedule around the random requests which came to us from the field. Instead we decided to have a positive program of our own. We decided to outline a series of meetings in one or more important subject-matter areas, and then to let it be known that we were prepared to present these meetings in any county where the county agent would request it.

We outlined the first series of this kind in the fall of 1951. The subject chosen was the economics of grassland farming. We used budgets to estimate the impact on a farming program of changing the percent of cropland in sod crops, with the forage utilized by different types of livestock programs. We also included brief discussions on outlook and on farm income tax. We decided to call these "Barnyard Economics" meetings. We had requests from and held meetings in 25 counties, with an average attendance of 80.

Judging from comments from the county agents who held the meetings and from farmers who attended, we decided that the meetings were sufficiently effective to repeat with a different series in the 1952-53 winter meeting period. After considering a number of possibilities for subject matter, we decided on dairy farm management as the main theme of the meeting. Dairying is the most important agricultural enterprise in Michigan. At the same time, we had on hand considerable research data on dairy farm management. Available data included feed-milk input-output responses over a wide range of inputs under Michigan conditions, grain-roughage substitution rates, and the results of improved dairy production practices. Much of the data had resulted from research done by Hoglund and Wilt at Michigan with the cooperation of the Bureau of Agricultural Economics. Many of the data had been obtained very recently, and since most had not been extended to farmers, we considered it important to take it to them and to help provide interpretation. We decided to apply the data

to three possibilities for increasing income on typical Michigan dairy farms: (1) increasing herd size, a problem of scale, (2) shifting to cows of higher productive ability, a problem concerning quality of resources, and (3) substituting good quality roughage for grain and protein supplement, a problem of input substitution. We used the budget method to estimate the impact of these changes on investments, labor inputs, gross income, expenses, and net earnings. Marginal data were used in budgeting the feed substitution problem. We also used data from our farm business analysis project. Three different sets of budgets were worked out for situations which are typical of different parts of Michigan.

As finally outlined, the meeting included a 15-minute presentation on outlook, 15 minutes on income tax changes and farm accounting, and one hour on dairy farm management. This was followed by 10 to 20 minutes of questions and discussion. Two specialists participated in each meeting and alternated on the program so that no presentation was longer than 20 minutes. An extensive set of visual aids was used in presenting the material. We had requests for the meeting from 77 county agents and held meetings in 77 of Michigan's 83 counties. In the lower peninsula, attendance ranged from 30 to 350 per county, and averaged 113. Average attendance in the upper peninsula was 49.

Appraisal of Barnyard Economics Meetings

Of the three functions of farm management extension which were outlined at the beginning, the Barnyard Economics meetings were designed primarily to provide data to farmers. Farmers were presented considerable data on production methods and responses, prices, and economic and social phenomena as they affect the dairy industry. Not only were data provided, but help was given in interpreting the data and suggesting how the changes suggested might fit into typical farm situations.

The material presented in the meetings did not give answers to questions of specific individual farmers. Three types of adjustments were suggested which might be profitable under typical farms situations (there may be a number of more feasible ways of increasing income on any particular farm). The individual farmer had to adapt the information in the light of his own resource situation, his managerial ability, his family status, and his family's personal goals and preferences. Important problems of transition from the present situation were not discussed. Follow-up help either individually or in small groups might have been worthwhile for those who later decided that they wanted to make the shifts suggested.

The Barnyard Economics meetings were not designed to teach managerial principles or decision making. In the meetings, we did describe the

procedure we used in outlining the present farm situation, setting up realistic alternatives, and budgeting to obtain an estimate of the outcome if the changes were made. We pointed out the general application of this procedure to other types of problems. We were gratified with the number of farmers who indicated from their comments after the meetings that they could see the general applicability of the procedure. However, it is too much to expect to accomplish a great deal in the way of teaching principles and procedures by such an incidental and indirect approach, and it seems realistic to assume that only the better farmers grasped the significance of the procedure itself.

We believe that the meetings were effective in accomplishing the purpose for which they were designed. We had greater attendance, more participation on the part of those attending, and more favorable comments from people in the field than we have ever had before on farm management meetings in Michigan. The meetings stirred up considerable interest and enthusiasm for farm management work which we believe will provide a good basis for future farm management activities.

Certainly the meetings were time consuming. Much time and work were involved in analyzing the data and organizing the material. In addition, two specialists were involved at each meeting. This is a serious consideration in allocating our time among the various activities which we would like to carry on. We plan to have another series of meetings this fall and winter. In order to increase the efficiency in the use of our time we are considering these possibilities: (1) preparing an extension publication at the same time we prepare the subject matter for the meetings, (2) making more use of the material on television, (3) preparing kinescopes and other visual aids which will make it possible for one specialist to present all of the material at the meeting.

There is a real question in my mind as to whether or not one series of meetings of this type each year will be sufficient to extend all of the new research information, let alone the teaching of principles and decision making. I believe that the output of research will come in such a stream that one series of meetings per year will not keep up. We now have in Michigan research information which is waiting to be taken to farmers, and we will soon have data from several studies which are underway to estimate the marginal productivity of resource categories. Perhaps it would be better to have the material less well prepared in order to have time to prsent more material. Television in Michigan has tended to influence our decisions on this point. Because of television, many farmers are becoming accustomed to listening to presentations which are all wrapped up into neat 15 or 30 minute packages. Therefore, we believe that it is vital to have our material "boiled down" and well presented.

But even so, we may have unduly sacrificed opportunities to present more subject matter by spending so much time on these meetings. We certainly don't have all the answers, and we realize it. We are convinced that we must have a positive program of our own and not wait until someone asks us to do something if we are to stay ahead of the better farmers. And we are always on the lookout for new and better ways of doing farm management extension work in order to accomplish the job which we believe it is our function to perform.

THE DEMAND FOR FARM PRODUCTS: AN APPRAISAL OF THE APPLICABILITY OF SINGLE EQUATION METHODS TO STATISTICAL DEMAND ANALYSIS FOR AGRICULTURAL COMMODITIES*

KARL A. FOX
Bureau of Agricultural Economics

Outline and Summary

CHAPTER I briefly summarizes the development of statistical demand analysis as a field of research, from its beginnings until about 1950.

Chapter II contains first, a brief exposition of the simultaneous equations approach, and second, a detailed discussion of the single equation model generally used by demand analysts. This model is treated as a special case of the more general simultaneous equations model. I attempt here to show under what conditions a single equation least squares demand function will yield unbiased estimates of demand elasticities and other "structural" coefficients.

Chapter III constitutes the real body of the thesis, accounting for 150 of its 230 pages. Chapter III is entitled "The Demand for Major Farm Products." First, some general considerations are presented as to the nature of consumer demand, the marketing system, supply and demand at the farm level, and the effects of aggregation (over consumers, producing areas, grades and varieties of a commodity, and so forth)—all from the standpoint of their implications for statistical analysis. The rest of the chapter is centered around some 15 "block diagrams" of the demand and supply structures for major farm products. For each major livestock product and type of crop, evidence, logical and statistical, is presented to answer the following question: Can the consumer demand function for this commodity legitimately be fitted by single equation methods? For many farm products, I concluded, the answer is yes, or yes with minor qualifications. For some other commodities it seemed clear that two or more demand and supply curves logically should be fitted at the same time.

The material of Chapter III, in a less technical form, has now been published as USDA Technical Bulletin No. 1081.

The final chapter (Chapter IV) summarizes the preceding discussion in terms of (a) areas of applicability of the single equation approach and (b) areas in which sets of simultaneous equations seem to be required. In

* Summary of award winning Ph.D. thesis filed at University of California (Economics).

relation to these latter areas, some qualifications are raised concerning the existence and accuracy of data and difficulties in specifying the structural model, or system of demand and supply equations, for any given commodity. It is suggested that the data requirements for obtaining significant coefficients by means of the simultaneous equations approach "are more exacting than has been commonly realized, and perhaps more exacting than many of our existing agricultural time series can support."

AN ECONOMIC ANALYSIS OF THE IMPACT OF THE PRICE SUPPORT PROGRAM UPON THE DEVELOPMENT OF THE POTATO INDUSTRY IN THE UNITED STATES*

Roger W. Gray
Bank of America

THE title of this thesis was intended to suggest some of the things which are *not in* the thesis. There is on file at a school in Texas a 600 page Ph.D. thesis entitled "The Left Turn Hopsa Step in the Lithuanian Polka." I have not read the thesis—but I think that the title is superb. In few words the author tells us, not just what his thesis is about—but what it is not about. You don't have to read his title carefully to learn that he is *not* writing about the *right* turn hopsa step or about the Charleston. In many more words, I have tried to indicate that I am writing about the potato price support program and not about price support programs in general, and that I am concerned not with an overall appraisal of the potato price support program, but with its impact upon the development of the potato industry.

With this introduction, I hope you will not be dismayed to learn from the following summary just how little there is to the thesis.

Summary

Per capita potato consumption in the United States declined from 180 to 100 pounds annually between 1910 and 1949. Various plausible explanations are usually advanced for this decline: rising real incomes, increasing availability of other foods, diet consciousness, urbanization, and the trend toward more sedentary occupations. Available evidence indicates, however, that per capita consumption was trending upward between 1870 and 1910, perhaps almost as rapidly as it has since declined. This fact created some doubt as to the validity of the common explanations of the decline, and led me to an analysis of the influence of migration on consumption patterns. The migration of millions of people from the less advanced economies of Europe where potato consumption was high, to the more advanced American economy where potato consumption was much lower, superimposed one consumption pattern over another and raised the United States potato consumption level. With the sharp decline in this migration between 1910 and 1915 came the beginninng of the very rapid decline in potato consumption in the United States.

The development of regional specialization in potato production since the turn of the century has followed a pattern which is related to the production and distribution characteristics of the commodity. At the turn of

* Summary of award winning Ph.D. thesis filed at University of Minnesota.

the century potato production was located in the same pattern as the population. This production pattern has been modified up to the present time. Early in the present century the corn belt states stopped producing their own potatoes and the states to the north of them started producing a surplus. Likewise, Maine started producing a commercial surplus for the New England population. These changes took place before per capita consumption was declining rapidly and in a period when the adjustment was relatively easy on both sides because of the prevailing market situation.

Following these episodes came a second adjustment which was more difficult and has consequently been of longer duration. This was a shift from the lake states (New York, Pennsylvania, Ohio, Michigan, Wisconsin, and Minnesota) toward a group of outlying specialist states including Maine, North Dakota, Colorado, Idaho, Washington, and Oregon. Major impediments to this adjustment, between 1910 and 1942, were the contracting market for potatoes, the absence of attractive alternative lines of production for the Lake state producers, and the extreme price variability from one year to the next in potatoes. Not only was there a slight downward trend in the aggregate demand for potatoes during this period but there was a sharp decline in the elasticity of demand as potatoes underwent the transition from a basic and substitutable dietary role to a smaller and more complementary role in an increasingly varied diet.

Beginning with the 1943 crop, potatoes were affected by the Steagall Amendment, which provided for price supports at not less than 90 percent of parity. The price support program created an unlimited market for potatoes at approximately the average price (in relation to parity) which had prevailed for 30 years, and virtually eliminated the risk of very low prices. Moreover, it came at a time when farm incomes were high and rising, so the alternative enterprises of the Lake state producers were becoming exceptionally attractive. Thus, without guaranteeing high prices, but merely by guaranteeing something close to the average free market price, the support program helped change the outlook of the individual potato producer.

The response to the program was immediate and of such magnitude as to be unmistakable. Growers in the outlying specialist states increased their plantings by one-third in 1943 and maintained the new higher acreage level until acreage restrictions were imposed. Growers in the Lake states, on the other hand, were more hesitant in their response, increasing acreage by only one-fifth in 1943 and reverting thereafter to the previous rapid downward trend in acreage.

The typical grower in the specialist states had been in a position for some time to produce potatoes profitably at the average equilibrium price.

But the risk was great that in any given year when he might decide to enlarge his operation the price might fall and imperil his investment. The expansion of the specialist had also been impeded by the tenacity of the small commercial producers throughout the Lake states, combined with the fact that there was no expanding market to absorb new production by the specialists. With the government now guaranteeing him a market, his natural response was to expand and intensify potato production.

The typical Lake state potato enterprise was in sharp contrast to the large scale enterprise in the specialist states. Potatoes comprised a cash crop sideline to dairying or livestock production in the Lake states, where the typical commercial grower planted from two to ten acres of potatoes. Favorable prices in all lines secured for these growers an income position which encouraged them to intensify their farming for greater efficiencies and higher output. This meant that each grower must decide whether to expand and intensify his potato enterprise or his alternative enterprises. Since most of them had dairy or livestock farming as the major enterprise, and since the seasonal labor requisite to any sizable potato enterprise was becoming scarcer, the majority of these sideline producers elected to drop potatoes from their farming scheme. In effect, then, most of the Lake state farmers did not respond directly to the program—they responded to favorable economic conditions.

A survey was conducted in several important potato producing areas in an effort to provide a partial test of some of the hypotheses arising in this study. The results indicate that the response to the program was greatest in the more specialized potato areas and where alternatives were less close, and least in the less specialized areas and where alternatives to potatoes were considered closer. Moreover, the growers in the specialist areas were favorably inclined toward the program and toward instituting some type of support program anew; whereas growers in the other areas did not like the program and were not in favor of any new support program.

The administration of potato price supports involved a number of complex problems, the most acute of which were interregional in nature. The program came in two phases: a first, non-restrictive phase (1943-45), during which increased production was sought; and a second, restrictive phase (1947-50), during which efforts were made to curb production. During the first phase the pre-existing locational adjustment was accelerated. During the second phase the existing locational pattern was virtually frozen, as efforts to forestall surpluses involved tying prices and acreages to historical bases. The acreage allotments program failed in its purpose of forestalling surpluses. Neither the acreage allotments program nor the procedure for determining state parity price equivalents appear to

have been altogether equitable. From the standpoint of resource allocation it appears that the earlier phase of the program produced desirable results in accelerating the movement toward the specialist areas, whereas the later phase of the program had undesirable results in precluding continued movement in this direction.

The price support experience undoubtedly contains lessons for the future. Some of the pitfalls of the past program could be avoided even under the same legislation. It is doubtful that the underlying problem which historically has confronted the potato industry has been mitigated, either by the price support program or by the new industry pattern which has evolved. The problem is the so-called "cobweb" interaction between production and price. One possible means of alleviating this problem would take the form of an income schedule plan, whereby next year's requirements would be estimated and a schedule of incomes ranging downward from the income which this estimated crop would bring (depending upon the amount by which this estimate is exceeded) would be guaranteed. This proposal is aimed directly at the "cobweb" interaction instead of being designed either to raise prices or encourage production.

Concluding Remarks

This ends my summary, but I would like to add just a few words. Judging by the accepted journalese, which has been adopted by many of us, it would have been appropriate to call this thesis a study of the "great potato fiasco." This might not have been inaccurate, but it certainly would have been incomplete—for I am convinced that if we have witnessed one fiasco we have witnessed two. We might do worse when we encounter reference to the "great potato fiasco" than to ask: "Which fiasco? The one in which the government bought a lot of surplus potatoes which were wasted? Or the preceding one in which, for example, the value of the average acre of potatoes in Maine fluctuated as follows:?"

1922	$102
1925	470
1926	328
1928	95
1932	62
1936	264

There have been no price supports on potatoes since the 1950 crop. Producers in Kern County, California are now ready to testify, I feel sure, that the pre-support fiasco has manifested itself again. It appears to me that, instead of being content with this alternation between two fiascoes, agricultural economists are justified in continuing to search for the golden mean.

SYSTEMS OF FARMING ADAPTED TO HIGHLY-PRODUCTIVE LEVEL LAND IN ILLINOIS*

W. N. Thompson
University of Illinois

THERE is considerable confusion in the corn belt regarding the best use of the area's agricultural resources, particularly land. This arises from a variety of reasons, some of which are:

1. Failure, on the part of many (including some agricultural leaders), to recognize the way in which corn-belt agriculture fits into the over-all agricultural and entire national economy;
2. Too little economic interpretation of the result of research in the technical sciences;
3. Changing product prices and factor costs;
4. Farm management recommendations that emphasize "desirable" goals for farmers without recognizing the economic consequences during the period of change from a "poor" to a "better" farm organization or operational plan;
5. Failure to distinguish between the soil erosion and the fertility depletion aspects of the soil conservation problem; and
6. Changing technologies, fertilization for example.

This thesis study was the begining of a planned series of studies of systems of farming adapted to different land and other resource combinations that are important in Illinois agriculture. Its scope was limited to "highly-productive level land" to delimit the problem to manageable proportions. Highly-productive level land is defined as land with soil productivity indexes[1] of 81 to 100 and with slopes of less than two percent. Limiting the study to land of this quality eliminated the problems of serious erosion and permitted concentrated attention on the problems of depletion which are in some ways less complicated. There are about seven million acres of this quality of land in Illinois, which is about 28 percent of the cropland of the state. It is concentrated in the northern two-thirds of the state, particularly in the cash-grain area of 25 counties in east-central Illinois. More than 80 percent of the cropland of some counties is of this quality.

Objectives

The objectives of the study were as follows:

1. To bring together the agronomic and economic principles which are im-

* Summary of award winning Ph.D. thesis filed at the University of Illinois.

[1] The soil productivity index, as used in Illinois, is an indication of the *relative* ability of a soil to grow crops. The most productive soils in the state are given an index of 100 and the least productive an index of 5 assuming a low level of management. See H. L. Wascher, et. al., *Illinois Soil Type Descriptions,* University of Illinois Department of Agronomy, processed report AG-1443, 1950, pp. 33-35.

portant to the farm manager who makes the decisions concerning the use of land;
2. To separate the facts known about the use of highly-productive level land from those things that are not known;
3. To establish the comparative advantage of different systems of farming on highly-productive level land in Illinois;
4. To study alternative systems of land use in terms of the economic rewards to those who control the use of the land and in terms of the level of soil conservation which each permits; and
5. To set up systems of land use for the quality of land under study that are consistent with the goals of farmers.

General Procedures and Sources of Data

This study was divided into two parts. The first involved a study in interregional competition in production and marketing of the products of highly-productive level land. In this part of the study the "trends method" was used to establish the comparative advantage of different systems of farming. This method has been described as "simply a common-sense way of laying out the record of past production, placing alongside it series of related factors, looking for interrelationships, and weighing their relative influence."[2]

Data were drawn from many secondary sources for the analysis of interregional competition. Analysis was made of the market for products of the quality of land under study, feed grain surpluses and deficits by states, trends in crop production, changes in relative prices of crops, location of the area with respect to grain processing industries and marketing centers, grain shipments, and trends in proportion of crops sold from farms. Brief attention was also given to institutional factors, such as tenure; and human factors, such as experience of the farmers in the area in production of different crops and livestock and livestock products.

The second part of the analysis was a study of alternative land-use systems. The direction of this part of the study was contingent upon results of the previous analysis of interregional competition.

The budgeting method was used in bringing out the merits and weaknesses of alternative systems of land use and in establishing the adaptability of these alternatives to different combinations of resources. It should be admitted that the contemplated study of "systems of farming" really became a study of "systems of land use." However, the two are virtually synonymous on intensive cash-grain farms.

Data for the budgets were taken from results of agronomic investigations, farm financial and production records, detailed cost account records, and studies of individual farms. Most of the data were far from ideal for

[2] Ronald L. Mighell and John D. Black, *Interregional Competition in Agriculture*, Cambridge: Harvard University Press, 1951, p. 39.

obtaining answers to the problems at hand. Results of many agronomic experiments were "spliced" together with the assistance of co-workers in agronomy.

Answers to two questions were sought in the analysis of land-use systems. First, what are the systems of land use that the grain farmer can follow which will help attain the goals of his cropping system? Emphasis was put on comparison of rotations including a standover legume crop and rotations with only a catch-crop legume.[3]

Second, how can the farmer make the transition from a system of grain farming that results in depletion of the soil and low yields to a more productive system that will not only ultimately result in high production and high earnings, but also will provide high earnings during the transition period? It was assumed that most farmers and landowners in the area under study have a high preference for current over future income.[4]

Conclusions—Interregional Competition

The analysis of forces underlying the supply of and demand for the products of highly-productive level land led to the conclusion that farmers on this quality of land are, and will continue to be, in an exceptionally favorable position to produce grain crops for feed, nonfeed uses, and exports. Some of the factors contributing to this general conclusion were:

1. The amount of land of the quality under study in the United States is very limited and the climate of the area is favorable for grain production, particularly for corn and soybeans.
2. Illinois is the largest feed grain surplus[5] producing state in the nation. The area studied is located toward the east edge of the feed grain surplus producing area of the United States and is bordered on the east and southeast by huge feed deficit areas. This gives the area a location advantage over feed surplus producing areas farther to the west.
3. Production of corn, the main feed grain, has increased by nearly 50 percent in the United States in the past 20 years. The large increases in production (bushels) have come from the corn belt states with the greatest percentage increases in the "fringe" states of South Dakota and Minnesota. These latter states are less favorably located with respect to eastern deficit areas than is eastern Illinois.
4. The cash-grain area of Illinois is an area of larger farms with a higher proportion of rented land, more grain-intensive cropping systems, and less intensive livestock systems than the cash-grain areas of Iowa and Ohio.
5. The cropping systems on many farms on highly-productive level land in Illinois have become more grain-intensive during the past 20 years.

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[3] The standover legume occupies the land a full year while the catch crop is seeded in a small grain crop and plowed down for soil improvement purposes preceding corn in the succeeding year.

[4] About 70 percent of the land in the area under study is operated by tenants.

[5] Difference between production and needs for livestock.

6. Prices of corn and soybeans in the area have increased relative to the prices of small grains and hay crops during the past half century.
7. The concentrated area of highly-productive level land in Illinois is conveniently located with respect to the grain marketing centers of Chicago, St. Louis, Peoria, and Indianapolis as well as interior processing centers.
8. The main movements of feed grains from Chicago are to the eastern and southeastern parts of the United States.
9. The feed grains, corn and oats, and soybeans are important sources of income to Illinois farmers and the quantities of these crops sold have increased as production has increased. The proportion of corn sold by farmers has remained about constant at 40 percent of production during the past 40 years. A similar share of the oats crop has been sold.
10. Illinois farmers sell a higher proportion of their corn than farmers in any other state, and sell more of their oats than farmers in any other corn belt state.
11. There are well established feed grain and soybean processing industries and marketing facilities in and near east-central Illinois.
12. There is a well established pattern of cash-grain farming on farms with highly-productive level land which will be slow to change because of a combination of historical, human, and institutional factors (irrespective of changes in demand for the grain products of the area).

The above conclusions do not preclude the existence of some grain-livestock and very intensive livestock farm organizations on farms with highly-productive level land. On the contrary, well organized and efficiently operated livestock enterprises have a definite place on those farms on which the manager has the capital, labor, ability, and willingness to efficiently convert feeds and other resources into livestock and livestock products. However, the opportunity cost of grains fed to livestock in this area is high. Efficiency in livestock production is imperative if farmers are to realize as much from their resources in livestock production as in an efficient system of grain farming.

Conclusions—Land-Use Systems

The conclusions regarding alternative land-use systems for grain farms which consisted of a synthesis of agronomic and economic principles and facts were as follows:

1. The legume catch-crop rotation is superior to the standover legume on highly-productive level Illinois land from the standpoint of value of crops produced and net returns. However, it creates peaks in labor, power, and machinery requirements on some farms.
2. Results of rotation and fertilization experiments indicate that the complementary relationship between forage crops (standover legumes) and grain crops does not exist under a grain system of farming with a high-level, balanced fertility program on the quality of land under study.
3. Rotations with two or three years of intertilled crops and one year of small grain with a legume seeding for a catch crop are high-profit rotations with a high-level, balanced fertility program.

4. While there are differences in production costs among different rotations, these differences are relatively small (except for differences in fertilizer costs) under most farm conditions.
5. Many farmers with highly-productive level Illinois land could increase production and net earnings by adopting a complete fertility program. While a corn price of $1.50 per bushel and comparable prices for other crops, and 1951 costs were used in the budgets, this conclusion would hold under less favorable price-cost relationships.
6. Farmers getting average yields in the area (about 60-bushel corn) can increase their fertility levels, yields, and *net earnings* during *each year* of the transition from their present land-use system to an improved, high-producing and high-profit system. This is done by putting the fertility build-up program on a "pay-as-you-go" basis.[6]

Suggestions for Further Research

The study of alternative systems of farming is a complex undertaking. A thesis study often raises more questions than it answers. This one is no exception. Further work is needed on a number of technical and economic questions related to the use of highly-productive level land.

1. More research is needed to determine the effects on yields of different combinations of crops and fertilizers in the rotation. Emphasis should be placed on finding the response from a range of inputs of fertilizer. Many fertilizer experiments are designed to show the response from "plenty" of fertilizer. The farmer needs to know the smallest amount of fertilizer that will give a particular response.
2. There are many questions about the relationship of response to nitrogen fertilization and weather conditions. Study needs to be made so the farmer can make a sound judgment of the probability of various responses to fertilization.
3. Study is needed of the importance of soil tilth, structure, and related factors as they affect plant growth. A study of the relative merits of stand-over and catch-crop legumes as they affect soil tilth should be included as a part of this problem.
4. Further study is needed to determine the best catch-crop legumes to use under different conditions. Studies of the cultural practices that result in the best growth of these crops are also needed.
5. A study of the many technical and economic aspects of the fertilizer industry would help answer the questions of those who are reluctant to recommend systems of land use that require large quantities of commercial fertiizers on the grounds that "the farmer cannot buy fertilizer today."
6. Further research is needed to determine the profitability of different combinations of crops in the rotation with varying yield and price relationships. This involves a more thorough study than has been made to date of the costs of producing crops in different rotations. The very delicate problems of complementary, supplementary, and competitive relationships among crops complicate this problem.

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[6] For a brief discussion of the "pay-as-you-go" program see the author's "Dollars and Cents in Land Use," *Illinois Farm Economics,* No. 212-213, February-March 1953, pp. 1,442-1,445.

7. Research is needed to determine practical measures so the farmer can tell what his "break-even points" are with different combinations of sizes and types of livestock enterprises. This is very important for the farmer in an area where there are a number of alternative organizations that may be adapted to his resources, the best one of which is so dependent on his managerial ability.

This study has illustrated the interrelationships between the work of those in the technical fields and agricultural economists. It is only through closer working relationships among these workers, both in research and extension, that the challenge of obtaining better use of our agricultural resources will be met.

MINUTES OF THE MEETING OF THE EXECUTIVE COMMITTEE OF THE AMERICAN FARM ECONOMIC ASSOCIATION, OREGON STATE COLLEGE, TUESDAY AUGUST 18, 1953

Present: Wellman, Cowden, Johnson, Morse, Witt, Butz, Trelogan, Mutti, Wood.

1. The meeting was called to order by President Harry Wellman.

2. Minutes of the preceding Executive Committee meeting were approved.

3. Harry Trelogan reported for the awards committee with the recommendations that: three awards of $250 each for outstanding theses for Ph.D. degrees in 1952 be awarded; and that three $250 awards for outstanding research reports published in 1952 be granted. (The names of the award winners are listed on the inside back cover).

Larry W. Witt reported the selection of the editorial committee on the best Journal article in 1952. After some discussion, it was decided to report to the general meeting the names of those receiving honorable mention for their work. (These awards are also listed on the inside back cover).

It was moved and seconded that the recommendations of the Awards Committee be accepted. These awards were announced at the Wednesday night session, following the student debate. The awards were made by President Wellman.

4. Dr. Joe Mutti, Advisor to the Student Chapter Section of AFEA, reported on the status of Student Sections. Eleven undergraduate clubs paid their dues for last year. There were six student debators present at the Oregon meetings to participate in the student debate. There was considerable discussion of the problem of selecting next year's officers. It was suggested that the Student Section hold nominations and elections by mail, much the same as the parent Association. It was voted to award members of the winning debate team a five-year subscription to the JOURNAL OF FARM ECONOMICS, members of the runner-up team a three-year subscription to the JOURNAL OF FARM ECONOMICS, and all participants in the debate a one-year subscription to the JOURNAL OF FARM ECONOMICS. Suitable certificates were presented to the participants in the debate at the time of the debate. The Secretary-Treasurer was instructed to send subscriptions to the participants beginning with the proceedings issue.

5. Larry Witt presented the editor's report. This appears later in this volume.

6. It was decided to use the $2.00 registration fee assessed at the annual meeting to cover local expenses. Inasmuch as this fee was authorized by previous action of the membership, it was requested that a full accounting of the fee and its disposition be made to the officers of the American Farm Economic Association. Any surplus remaining from the fee, after local expenses are met, will be split equally between AFEA and WFEA.

7. It was decided that the cost of printing the program for the annual meeting would be divided equally between AFEA and WFEA.

8. The Secretary-Treasurer presented his report on the year's business, which was accepted. This is published later in this volume.

9. The Secretary-Treasurer presented a report of the Investment Committee, which was accepted.

10. President Tom Cowden was instructed to investigate the cost of hiring a Trust Company to keep the securities owned by the AFEA. He was also

instructed to investigate the cost of increasing the bond carried on the Secretary-Treasurer. He was further authorized to make appropriate changes.

11. The editor was authorized to expand the number of pages in the JOURNAL OF FARM ECONOMICS by 96 pages during the coming year. This will be a total expansion of 24 pages per issue. The new budget will allow for this.

12. The Secretary-Treasurer was authorized to release the JOURNAL mailing list to persons and organizations for strictly professional purposes, with an appropriate charge being made.

13. The new Executive Committee will convene at 1:00 P.M., Wednesday, August 19.

Meeting was adjourned.

EARL L. BUTZ, *Secretary-Treasurer*

MINUTES OF THE ANNUAL BUSINESS MEETING, WEDNESDAY, AUGUST 19, 1953

President Harry Wellman called the meeting to order at 8:00 A.M. and presented his report, which is appended.

The Secretary-Treasurer made his report, which is appended.

The report of the auditors was submitted and approved. It is appended.

The report of the investment committee was given and accepted.

Editor Larry Witt made his report, which is appended.

D. Gale Johnson presented the following resolution:

"I move that the following statement be sent to President A. L. Strand, to Dr. G. B. Wood, Chairman of the Department of Agricultural Economics, and to the persons specifically mentioned in the statement:

"The American Farm Economic Association wishes to express its appreciation to Oregon State College for the use of the excellent facilities of that institution. The members of the Association have been the recipients of a very cordial hospitality which has been maintained within the framework of a highly efficient organization of all the services required for a meeting of this size.

"It has taken the efforts of many different individuals to prepare for this meeting. We can not directly recognize all of those who have contributed their time and effort, though we are highly indebted to the many who have contributed so greatly to our comfort and to the success of the meeting. We would like specifically to thank the following for their considerable efforts on our behalf:

1. The Administration of Oregon State College;
2. The Department of Agricultural Economics of Oregon State College;
3. The members of the Local Arrangements Committee: Mr. George Karzan, Chairman, Mr. Curtiss Mumford, Mr. Manning Becher, and Mr. William Vrooman.
4. Mrs. Edith Platt, Chairman of the Ladies' Committee."

It was moved by O. V. Wells and seconded by Joseph Ackerman that President Cowden appoint a special committee to solicit additional contributions to the Special Grants Fund. The Executive Committee was also instructed to review the whole awards program and make any pertinent suggestions.

Joseph Ackerman made a brief report on plans for the International Conference of Agricultural Economists in Finland in 1955.

It was moved by R. G. Bressler, Jr. and seconded by Raleigh Barlowe that the Executive Committee (or the President) of the AFEA be authorized to explore the arrangement of a full joint meeting with the Allied Social Science groups in December about every third year. This motion carried by a voice vote. It was then suggested that cooperation with the American Marketing Association should not be overlooked when arranging joint meetings.

President Tom Cowden stated that the 1954 meetings would be at Pennsylvania State College on August 23 to 25. He further stated that plans were under way for joint sessions with the American Economic Association and the American Statistical Association at Washington, D.C. in December, 1953.

It was moved by D. Gale Johnson and seconded by O. V. Wells that the Executive Committee of AFEA be authorized to explore the possibility of setting up an Advisory Committee to government agencies on the agricultural statistical data they collect and disseminate for use by agricultural economists.

Retiring President Harry Wellman then introduced the incoming President Tom Cowden and other newly elected officers. Cowden spoke briefly.

The meeting was adjourned.

EARL L. BUTZ, *Secretary-Treasurer*

REPORT OF THE PRESIDENT

In the year 1805 Lewis and Clark blazed the Oregon Trail. One hundred and forty eight years later the members of the American Farm Economic Association were venturesome enough to follow in the footsteps of those two great explorers, and to assemble in the heart of the Willamette Valley of Oregon for a joint meeting with the Western Farm Economic Association. It can now be said that, having come to the Pacific Coast, the American Farm Economic Association is truly a national organization.

But, seriously, we from the West are delighted with the good turnout from other sections of the country, especially from the Mid-West. We bid you a most hearty welcome, and we shall look forward hopefully to your return before too many years have passed.

This has been another good year for the Association. The steady progress of recent years has continued through 1952-53. Our Association has gained in membership, in financial strength, and, I believe, in influence.

One matter only has caused me concern. We are growing apart from our sister organizations. The values which we formerly gained from holding our annual meetings at the same time and place as the annual meeting of the American Economic Association and the American Statistical Association were substantial ones. Their loss is regrettable. To be sure, our present policy of summer meetings has proven to be highly successful, and if I had to choose between all summer meetings or all winter meetings I would certainly adhere to summer meetings. But would it not be both feasible and desirable to substitute a full-fledged winter meeting for a summer meeting once in every three or four years?

Last January I was fearful that the incoming Republican Administration might wreck our organization. As you will recall, one of our Vice Presidents, True D. Morse, and our Secretary-Treasurer, Don Paarlberg, were persuaded to accept high positions in Washington, D.C. Don Paarlberg felt that it was necessary for him to give up his duties as Secretary-Treasurer, but fortunately for us, Earl L. Butz, very capably stepped into the breach.

Many others in our membership have labored diligently and well during the year now coming to a close; Larry Witt, Editor of the JOURNAL, Harry Trelogan, Chairman of the Committee on Awards, D. Gale Johnson, Chairman of the Committee on Farm Employment Estimates, Fred V. Waugh, Editor of the book of *Readings on Agricultural Marketing*, E. C. Young, Chairman of the Investment Committee, R. J. Mutti, Chairman of Student Section Committee, and G. E. Korzan, Chairman of the Committee on Local Arrangements, to mention only a few. Also, I must add the name of Maurice Kelso, President of the Western Farm Economic Association, who shared with me the responsibility of arranging the program for this joint meeting. He joins with me in thanking all who accepted places on the program.

It is an honor and a privilege to be President of this Association.

HARRY R. WELLMAN, *President*

REPORT OF THE ELECTION TELLERS

The count of the ballots showed the following officers elected for 1953-54:

President-Elect	Joseph Ackerman
Vice-Presidents	G. Burton Wood
	Earl O. Heady
Secretary-Treasurer	Earl L. Butz

Tellers: R. G. BRESSLER, JR.
HAROLD HALCROW

REPORT OF THE SECRETARY-TREASURER

The American Farm Economic Association experienced a healthy growth during the past year, both in membership and in net worth. Indeed, both membership and net worth of the Association have increased steadily since the organization was founded, with the exception of a brief interval during World War II.

The past year has shown a substantial growth in membership, as shown by the table:

NUMBER OF MEMBERS AND SUBSCRIBERS, JULY 1, 1950-1953

	1950	1951	1952	1953	Net change 1952 to 1953
Regular members	1279	1515	1534	1594	+60
Junior members	160	149	107	208	+101
U. S. Libraries and firms	313	307	321	304	−17
Foreign Libraries and firms	220	272	317	341	+24
Exchanges	12	12	0	1	+1
Total	1984	2255	2279	2448	+169

Membership is at an all-time high, showing a net gain of 169 over the year previous Of these, 60 were regular members and 101 were Junior members. A large proportion of the Junior members become regular members when they complete their graduate work.

It is of interest to note that the JOURNAL OF FARM ECONOMICS is mailed to 43 nations outside the United States. Our individual memberships include 84 Canadians and 143 foreign persons. In addition, a total of 341 foreign libraries and firms receive the JOURNAL OF FARM ECONOMICS.

Financially, the Association has had one of its most successful years. Wheras a gain of $500 had been anticipated in the budget, an actual gain of $1886.50 was experienced. When allowance is made for appreciation of securities held by the Association, the net worth increased $2159.80 during the past year.

It should be noted that the awards made at the annual meeting for winning Ph.D. theses and JOURNAL articles are made out of the Special Grants Fund. At the close of last fiscal year a balance of $11,020.68 remained in this Fund. Additions to this Fund would be welcomed by the Executive Committee.

The successful financial record of the Association during the past year, as during all the former years of its existence, may be attributed to the unselfish generosity of the unpaid men who have given their time, and the unpaid institutions which have provided clerical help for the various officers. This is particularly true of the offices of the Editor and the Secretary-Treasurer.

INCOME AND EXPENSE STATEMENT

	Actual 1951-52	Actual 1952-53	Budgeted for 1952-53
Income			
Dues	$11,107.95	$11,339.31	$11,500.00
Back numbers	789.60	930.99	600.00
Reprints	372.00	1,042.41	800.00
Advertising	401.80	315.00	500.00
Annual meeting	—	73.06	500.00
Collected for WFEA	307.38	399.00	300.00
Collected for CAES	88.50	165.00	100.00
Collected for Student Section	85.00	28.60	100.00
Dividends and interest	2,527.16	2,864.64	2,500.00
Other	12.14	61.68	100.00
Total	15,691.53	17,219.69	17,000.00
Expenses			
Journal printing	12,496.53	11,043.73	13,500.00
Reprints		843.70	
Back numbers	457.25	62.00	300.00
Postage and wires	286.12	341.72	400.00
Annual meeting	143.91	710.49	500.00
Editorial expense	697.50	774.90	700.00
Office supplies	950.90	403.78	400.00
Paid to WFEA	316.88	403.50	300.00
Paid to CAES	90.85	161.09	100.00
Student Section	—	88.55	100.00
Other	213.75	191.91	200.00
Total	15,653.69	15,025.37	16,500.00
Net gain (unadjusted)	37.84	2,194.32	500.00
Interest earnings allocated to Special Grants Fund	336.90	307.82	307.82
Net gain	(—299.06)	1,886.50	192.18

FINANCIAL STATEMENT

Assets	July 1, 1952		July 1, 1953	
Cash in bank	$ 7,595.29		$ 8,189.61	
Market value of stocks	37,140.15		38,322.50	
Market value of bonds	29,458.81		28,489.81	
		$74,194.25		$75.001.92
Liability to Special Grants Fund		12,312.86		11,020.68
Liability to Student Section AFEA		77.50		17.55
Net worth		$61,803.89		$63,963.69

ADJUSTMENTS TO SPECIAL GRANTS FUND

On hand July 1, 1952	$12,312.86
Interest earned during year	307.82
	12,620.68
Awards made during year	1,600.00
On hand July 1, 1953	$11,020.68

ADJUSTMENTS IN NET WORTH

	1951-52		1952-53	
Net worth at beginning of year		$59,840.32		$61,803.89
Net gain	−299.06		1,886.50	
Change in Inventory Value of stocks	9,443.03		1,182.35	
Change in Inventory Value of Bonds	−9,525.19		−969.00	
Change in Liability to Student Section	−77.50		+59.95	
Net Change from Purchase and Sale of Securities	2,422.29		0	
		1,963.57		2,159.80
Net worth at end of year		$61,803.80		$63,963.69

EARL L. BUTZ, *Secretary-Treasurer*

REPORT OF THE AUDITORS

At the request of the President of the American Farm Economic Association, we have examined the accounts of the Secretary-Treasurer, Don Paarlberg, for the period July 1, 1952 to January 9, 1953, and Earl L. Butz for the period January 10, 1953 to June 30, 1953.

We have checked all disbursements recorded in the Disbursements Journal against the record of the check book. Although individual income entries were not checked, the total of gross receipts was verified as to its aggregate level. Both the cash receipts and cash disbursements books were found to be in balance. The treasurer's report of income and expenses and the financial statement for the period indicated were found to reflect accurately his records of the transactions and the financial position of the Association. The balance

on the July 30, 1953 bank statement corresponded to the cash in bank figure of the Financial Statement. The securities belonging to the Association were found to be in order in the bank box.

Respectfully submitted,

R. L. STUCKY
H. G. DIESSLIN

REPORT OF THE EDITOR

The editor wishes to express his deep appreciation to Dr. Raleigh Barlowe for taking over most of his functions during the past year. The detailed work on the large Proceedings and the November issue and nearly all the work on the February issue was done by Dr. Barlowe. While the editor was available by correspondence for major decisions, he sincerely appreciated that there were no major decisions brought to his attention.

There were an unusually large number of manuscripts submitted to the *Journal* during the past year. In reviewing this material the Editorial Council was called upon for an unusually large amount of help. In addition a number of other individuals not on the Council willingly consented to review particular manuscripts. Among these were Martin Abrahamsen, Kenneth Bachman, W. Edward Beach, Glenn Burrows, Forrest Clements, Harold Halcrow, Cecil Haver, John Hazard, W. E. Hendrix, Clifford Hildreth, O. B. Jesness, G. M. Kuznets, William Nicholls, Richard Nolte, Phillip Raup, Layton Thompson, John Timmons, Lazer Volin, Fred Waugh, Walter Wilcox, and many members of the staff at Michigan State College. The help of these people is very much appreciated.

Again thanks are due to Dr. Harold Halcrow for handling the book review section.

The 1952-53 issues of the *Journal* contain 1024 pages of which 412 pages represent the Proceedings. The smaller size of the 1952 Proceedings issue compared with 1951 resulted in slightly smaller expenses than budgeted. The pages in the regular issues have been increased somewhat to help in publishing more of the qualified articles received. Nonetheless it has been necessary to turn down more than the usual number of articles. The editor is requesting authorization for a further expansion in the size of the regular issues.

Nearly all of the manuscripts submitted to the *Journal* deal with research problems and results. Teaching and particularly extension problems are seldom written up. For those unwilling to prepare an article, a short note of 3 to 5 pages on new extension ideas, techniques or experiences may well be appropriate. It is believed that such reports would add to the usefulness of the *Journal* and to the number of potential subscribers.

LAWRENCE W. WITT, *Editor*

MINUTES OF THE EXECUTIVE COMMITTEE MEETING, AUGUST 19, 1953

Present: Cowden, Wellman, Ackerman, Wood, Heady, Witt, Butz, Morse, Johnson, Calhoun, Mason, Kelso.

Meeting called to order by President Cowden.

A budget for 1953-54 was suggested by the Secretary-Treasurer as follows:

BUDGET FOR 1953-54
AMERICAN FARM ECONOMIC ASSOCIATION

	Actual 1952-53	Budget 1953-54
Income		
Dues	$11,339.31	$11,500.00
Back numbers	930.99	900.00
Reprints	1,042.41	1,000.00
Advertising	315.00	500.00
Annual meeting	73.06	00.00
Collected for WFEA	399.00	400.00
Collected for CAES	165.00	150.00
Collected from Student Section	28.60	50.00
Dividends and interest	2,864.64	2,500.00
Other	61.68	100.00
Total	$17,219.69	$17,100.00
Expenses		
Journal printing	11,043.73	12,000.00
Reprints	843.70	900.00
Back numbers	62.00	200.00
Postage and wires	341.72	400.00
Annual meeting	710.49	600.00
Editorial expense	774.90	800.00
Office supplies	403.78	400.00
Paid to WFEA	403.50	400.00
Paid to CAES	161.09	150.00
Student Section	88.55	50.00
Other	191.91	200.00
Interest earnings allocated to Special Grants Fund	307.82	275.00
Total	$15,333.19	$16,375.00
Net gain	$ 1,886.50	$ 725.00

It was moved that the budget be adopted as a guide rather than as an inflexible document. The motion was passed.

President Cowden was authorized to proceed with plans to secure a grant to enable financial assistance for travel to the annual meeting for outstanding graduate students. This motion was made by Wellman, seconded by Heady.

President Cowden instructed President-Elect Ackerman to investigate dates regarding the 1955 winter meetings with the Allied Social Science groups, and to report back to the Executive Committee.

President Cowden announced that he was appointing Ernest Baughman and Don Henry to investigate the advisability of transferring the AFEA securities to a Trust Company for management and safekeeping.

President Cowden appointed a committee to make recommendations on the activities of the Student Section as follows: Joseph Ackerman, chairman, Joe Mutti and Earl Butz.

Lawrence W. Witt was appointed editor of the *Journal* for the coming year.

President Cowden mentioned that he would welcome suggestions from anybody regarding next year's annual meeting program.

Adjournment.

EARL L. BUTZ, *Secretary-Treasurer*

MINUTES OF ANNUAL MEETING OF THE WESTERN FARM ECONOMICS ASSOCIATION COUNCIL, CORVALLIS, OREGON, AUGUST 18, 1953

President Kelso presided.

The report of the Secretary-Treasurer as of July 31 was presented, and accepted on motion by Hobson. This report follows, amended to August 31 to include membership dues paid at the Conference.

A. H. Harrington presented the report of the committee to review the financial status of the Association. Other members of the committee were R. E. Seltzer and B. C. Swerling. Their recommendations are as follows:

"1. With our sizeable graduate student enrollment in the western colleges, our best opportunity to strengthen WFEA is to encourage participation by these students while they are in college (at the Junior-Membership rate) with the expectation that they will provide accumulative increase in membership in the future. Greater effort on the part of each member, as well as councilmen, to encourage Junior Memberships and Full Membership is recommeded.

"2. In line with the current practice of the AFEA it is recommended that a registration fee of $1.00 be collected at the annual Conference, the receipts of which to be used as needed by the host institution and the Executive Committee of the WFEA to defray conference expenses, with any remainder to go into the Association treasury.

"3. With the probability of a joint Conference with AFEA one out of every four years (with joint proceedings which materially reduces the WFEA proceedings cost for that year), and with the probability that in other years many tasks related to the publication and distribution of the Proceedings will continue to be done below cost, no increase in membership dues, or sale of advertising in our Proceedings, should be considered at the present time."

Upchurch moved that the Council accept the report of this committee, with thanks for their efforts. Seconded. Passed.

After discussion, Bice moved the adoption of the committee's recommendation that a registration fee of $1.00 be collected at the annual Conference. Seconded. Passed.

Recommendation was made that in accordance with the first recommendation of the committee, an application form for student or junior membership be prepared, similar to that used by the American Farm Economic Association.

Upchurch moved that the Secretary prepare a suitable form, and distribute a supply to each of the western colleges. Seconded. Passed.

Suggestion also was made that the receipt-of-dues card be sent to each student member as identification of his membership.

Upchurch had previously submitted to the Executive Committee a suggestion for a WFEA Journal of "Western Farm and Ranch Economics," as a means of increasing interest in, and financial support of, the Association. Huffman stated the question: should WFEA provide a place where things pertinent to the West can be published as a service to the membership, or should the Association continue with the annual Conference as its only major activity?

After discussion of this suggestion, Seltzer moved that the incoming President of the Association appoint a committee to explore the possibility of the Association providing more services for the membership. Seconded. Passed.

Burdick suggested that in addition to the annual Conference, local or subregional meetings be held at other times of the year. Mention was made

that such a meeting had been held in the San Francisco Bay Area with some regularity, the most recent at Stanford University last April. Fischer explained that Oregon State College has a local chapter of WFEA, which holds an evening meeting each month during the school year.

Kelso stated that the American Association for the Advancement of Science is to meet in San Francisco in 1954, and that at his request, Upchurch had represented WFEA in planning the program for that meeting.

According to the WFEA constitution, the Council selects two candidates each for the office of President-Elect and Vice-President to be presented in nomination at the Annual Business Meeting. The Council selected R. G. Bressler and M. L. Upchurch as nominees for President-Elect and R. E. Huffman and R. E. Seltzer as nominees for Vice-President.

Kelso asked that Montana State College be permitted to withdraw its invitation for the Association Conference in 1954, because of delays in the construction of new dormitory facilities on the campus. Instead, they would prefer to extend an invitation for 1955.

Burdick extended an invitation for the Association to meet in Estes Park, Colorado, in 1954, at the Y.M.C.A. Conference Grounds. He and Bice described the location and the facilities.

Hopkins moved that the Council recommend that the Association accept Colorado's invitation for 1954, and Montana's invitation for 1955. Seconded. Passed.

The Council meeting adjourned.

WENDELL CALHOUN, *Secretary-Treasurer*

REPORT OF THE SECRETARY-TREASURER, AUGUST 31, 1953, WESTERN FARM ECONOMICS ASSOCIATION

Membership

1952:	Members of WFEA only	162	
	Joint members with AFEA	335	
	Corporate members	4	
	Total		501
1953:	Members of WFEA only	161	
	Joint members with AFEA	375	
	Corporate members	4	
	Total		540

Finances

September 1, 1952—August 31, 1953

Cash on hand September 1, 1952		$1,166.77	
Receipts:			
Membership dues, Sept. 1, 1952-Aug. 31, 1953:			
Individual	$907.12		
Corporate	100.00		
		1,007.12	
Sale of Proceedings		207.56	
			$2,381.45

Expenditures:

1952 Proceedings—650 copies	$595.00		
Distribution of Proceedings to members	52.16		
		647.16	
Envelopes and postage (other than for Proceedings)		76.50	
Addressograph plates and addressing		21.12	
WFEA letterheads for 1952-53 (and WFEA envelopes)		44.96	
Rubber stamp		2.10	
Misc. purchases: 1 copy 1930 Proceedings		1.25	
			793.09
Cash on hand September 1, 1953			$1,588.36

WENDALL CALHOUN, *Secretary-Treasurer*

MINUTES OF ANNUAL BUSINESS MEETING OF THE WESTERN FARM ECONOMICS ASSOCIATION, CORVALLIS, OREGON, AUGUST 18, 1953

President Kelso presided.

Minutes of the last annual business meeting as published in the 1952 Proceedings were accepted without correction.

The report of the Harrington Committee to review the financial status of the Association and a report of the Council action pertaining to it were presented. After brief discussion, motion was made and passed that a $1.00 registration fee be charged at the annual Conference of the Association. Discussion brought out that, for those years in which the Association meets jointly with the American Farm Economic Association, registration fees would be arranged jointly by the two organizations.

Kelso explained the status of invitations for the 1954 and 1955 annual Conferences, and the earlier action of the Council. Following descriptions of the facilities that would be available at each location, Stucky moved that the Association accept the invitation of Colorado for 1954, with preference for the last week of July. Seconded. Passed.

Motion passed, that Montana's invitation for 1955 be accepted.

Motion passed, that the officers of the Association be instructed to extend the appreciation of WFEA to the American Farm Economic Association for participating in this Joint Conference.

Motion passed, that the members of the Association extend their sincere appreciation to Oregon State College for hosting this Joint Conference, and for the splendid facilities and services that had been provided. To Oregon State College, a large vote of thanks! Passed unanimously, with applause.

The Council presented the following nominations for officers to be elected for 1953-54:

President-Elect: R. G. Bressler
M. L. Upchurch
Vice-President: R. E. Huffman
R. E. Seltzer

There being no further nominations from the floor, it was moved and passed that nominations close.

The annual business meeting of the Association was adjourned.

WENDELL CALHOUN, *Secretary-Treasurer*

OFFICERS
WESTERN FARM ECONOMICS ASSOCIATION, 1953-54

President: Howard G. Mason, University of Nevada
President-Elect: R. G. Bressler, University of California
Past President: M. M. Kelso, Montana State College
Vice-President: Roy E. Huffman, Montana State College
Secretary-Treasurer: Wendell Calhoun, Bureau of Agricultural Economics

STATE COUNCILMEN, 1953-54

Arizona	Andrew Vanvig
California	Jerry Foytik
Colorado	S. Avery Bice
Idaho	Scott A. Walker
Montana	Layton S. Thompson
Nevada	Frank S. Scott, Jr.
New Mexico	W. P. Stephens
Oregon	Charles M. Fischer
Utah	Wells M. Allred
Washington	Barnard D. Parrish
Wyoming	J. R. Tompkin

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1953

SUBJECTS

AUTHORS

(Articles are indicated by asterisks)

NOTES

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AWARDS FOR RESEARCH IN AGRICULTURAL ECONOMICS, 1953

To recognize and encourage meritorious research, the American Farm Economic Association made seven awards in 1953: one of $100 for the best article appearing in the JOURNAL OF FARM ECONOMICS during 1952; three of $250 each for the best research reports published during 1952; and three of $250 each for the best theses submitted during 1952 in partial fulfillment of requirements for Doctor of Philosophy degrees. The recipients of these awards were:

Best Journal Article

Elmer J. Working	"Appraising the Demand for American Agricultural Output During Rearmament," May, 1952

Honorable Mention

Dale Hathaway and Lawrence Witt	"Agricultural Policy: Whose Valuations," August, 1952
Kenneth L. Bachman	"Changes in Scale in Commercial Farming and their Implications," May, 1952

Outstanding Ph.D. Theses

Karl August Fox	"An Appraisal of the Applicability of Single Equation Methods to Statistical Demand Analysis for Agricultural Commodities"
Roger W. Gray	"An Economic Analysis of the Impact of the Price Support Program upon the Development of the Potato Industry in the United States"
William Neil Thompson	"Systems of Farming Adapted to Highly-Productive Level Land in Illinois"

Outstanding Published Research Reports

William Bredo and Anthony S. Rojko	"Prices and Milksheds of Northeastern Markets"
Earl O. Heady	"Economics of Agricultural Production and Resource Use"
Glenn L. Johnson	"Burley Tobacco Control Programs—Their Over-all Effect on Production and Prices, 1933-50"

H. R. WELLMAN, *President*

For announcement of the awards to be made in 1954, see the News Items of the regular November, 1953 issue of *This Journal.*

Editorial communications including manuscripts submitted for publication or inquiries concerning the JOURNAL should be addressed to Lawrence W. Witt, 20 Agricultural Hall, Michigan State College, East Lansing, Michigan. Communications concerning books for review should be addressed to Harold Halcrow, University of Connecticut, Storrs, Connecticut.

Applications for membership or inquiries regarding the general affairs of the Association should be addressed to Earl L. Butz, Purdue University, Lafayette, Ind.

Non-member subscription rates $5 annually.

GEORGE BANTA PUBLISHING COMPANY, MENASHA, WISCONSIN